Technical Report 1344

Decision Support Tool Prototype for the Enlistment Incentive Review Board: Phase 2

Tirso E. Diaz and Paul J. Sticha
Human Resources Research Organization

Patrick Mackin
SAG Corporation

Paul Hogan
The Lewin Group

Samuel Rinde
SAG Corporation

Irwin Jose
U.S. Army Research Institute

July 2014

United States Army Research Institute for the Behavioral and Social Sciences

U.S. Army Research Institute
for the Behavioral and Social Sciences

Department of the Army
Deputy Chief of Staff, G1

Authorized and approved for distribution:

MICHELLE SAMS, Ph.D.
Director

Research accomplished under contract
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Human Resources Research Organization

Technical Review by:

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Kate A. LaPort, U.S. Army Research Institute

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REPORT DOCUMENTATION PAGE

1. REPORT DATE (dd-mm-yy) July 2014	2. REPORT TYPE Interim	3. DATES COVERED (from. . . to) February 2012 to May 2013

4. TITLE AND SUBTITLE Decision Support Tool Prototype for the Enlistment Incentive Review Board: Phase 2	5a. CONTRACT OR GRANT NUMBER W5J9CQ-12-C-0014
	5b. PROGRAM ELEMENT NUMBER 622785
6. AUTHOR(S) Tirso E. Diaz, Paul J. Sticha; Patrick Mackin; Paul Hogan; Samuel Rinde , Irwin Jose	5c. PROJECT NUMBER A790
	5d. TASK NUMBER
	5e. WORK UNIT NUMBER 501
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Human Resources Research Organization 66 Canal Center Plaza, Suite 700 Alexandria, VA 22314	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Research Institute for the Behavioral and Social Sciences 6000 6th Street (Bldg 1464 / Mail Stop 5610) Fort Belvoir, VA 22060	10. MONITOR ACRONYM ARI
	11. MONITOR REPORT NUMBER Technical Report 1344

12. DISTRIBUTION/AVAILABILITY STATEMENT: Distribution Statement A: Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES Subject Matter Expert and POC: Elizabeth A. Rupprecht

14. ABSTRACT *(Maximum 200 words)*:

The Army offers enlistment incentives—cash bonuses, educational support, and educational loan repayment—to encourage applicants to choose military occupational specialties (MOS) with the greatest need at longer terms of service (TOS). Within the Army, the Enlistment Incentive Review Board (EIRB) determines incentive types, levels, amounts, and qualification criteria as part of its quarterly review process. We had previously developed a job choice model (JCM) to predict applicants' MOS and TOS choices as a function of enlistment incentives. We then implemented the JCM within a proof-of-concept decision support tool (DST). The DST demonstrated the utility of the approach, but had several limitations, which became the focus of the current effort. With the support of the Army Research Institute, we sought to expand the functionality of the DST to produce a viable tool for allocating incentives to meet enlistment goals. To accomplish this goal, we revised the JCM using an expanded choice set, validating it with three different samples. We developed additional models to forecast the effect of economic conditions and recruiting funding on the quality of applicants and to estimate the total cost of the incentives. We then implemented the revised JCM and additional models in a prototype DST.

15. SUBJECT TERMS

Enlistment, Choice modeling, Classification, Incentives

SECURITY CLASSIFICATION OF			19. LIMITATION OF ABSTRACT	20. NUMBER OF PAGES	21. RESPONSIBLE PERSON
16. REPORT Unclassified	17. ABSTRACT Unclassified	18. THIS PAGE Unclassified	Unlimited Unclassified	85	Dorothy Young 703-545-2316

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Tirso E. Diaz and Paul J. Sticha
Human Resources Research Organization

Patrick Mackin
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Paul Hogan
The Lewin Group

Samuel Rinde
SAG Corporation

Irwin Jose
U.S. Army Research Institute

Personnel Assessment Research Unit
Tonia S. Heffner, Chief

U.S. Army Research Institute for the Behavioral and Social Sciences
6000 6th Street, Building 1464
Fort Belvoir, VA 22060

July 2014

DECISION SUPPORT TOOL PROTOTYPE FOR THE ENLISTMENT INCENTIVE REVIEW BOARD

EXECUTIVE SUMMARY

Research Requirement:

Army recruitment activities must meet the continuing need for Soldiers who are qualified to perform each of the more than 100 entry-level Military Occupational Specialties (MOS) required for an effective military force. To encourage the applicant to choose MOS where the need is greatest at a longer term of service (TOS), the Army offers a variety of enlistment incentives, including cash bonuses, educational support, and repayment of educational loans. MOS incentive types, levels, amounts, and qualification criteria are determined by the Enlistment Incentive Review Board (EIRB) as part of its quarterly review process.

In order to set the levels and types of incentives that allow the Army to meet its accession requirements at the lowest cost for incentives, the EIRB needs to know about the process that applicants use to decide among the MOS that they are offered. In prior research, we specified, estimated, and validated a job choice model (JCM) that represents Army applicants' MOS and TOS enlistment preferences as a function of enlistment incentives. We then implemented the JCM within a proof-of-concept decision support tool (DST) for setting incentives. Although the proof-of-concept DST demonstrated the value of a tool for informing the EIRB in the allocation of incentives to MOS and TOS enlistment options, the proof-of-concept DST had several limitations, which have become the focus of the current development effort. The primary goal of the work described in this report is to expand the analytic features and functionalities of the DST to make it a viable tool for the EIRB in allocating incentives to meet enlistment goals and budget constraints for future quarters.

Procedure:

To meet the goals of this research, we revised the JCM using actual applicant choice data from the first two quarters of FY 2010. We estimated the model parameters using an expanded set of job choices that approximate the total choices that were available to applicants, rather than the choices that were offered to them by the Army's Recruit Quota System (REQUEST). We validated the JCM in three ways: (a) within the estimation sample, (b) in a hold-out sample in the same time period as the estimation sample, and (c) in an out-of-period sample.

We developed two additional models to facilitate the use of the JCM to aid the EIRB. The first of these models estimates the effect of market conditions on the quality distribution of applicants. This model uses existing econometric data to predict changes in the number of high quality applicants as a function of the overall unemployment rate, relative military pay, the number of production recruiters, and the level of advertising for enlistments. The second model estimated the total cost of the incentives, considering the number of applicants who choose each incentive, the incentive levels chosen, and the likelihood that the applicants will remain in the Army long enough to be qualified to obtain the incentive benefits.

We then implemented the analysis capabilities of the JCM and the additional models in a prototype DST that allows users (e.g., EIRB members) to specify incentive policy scenarios, predict applicant enlistments by MOS and TOS, estimate the cost for each policy scenario, and compare the results across different policy scenarios.

Findings:

The estimated JCM was demonstrated to meaningfully characterize the effects of incentives on applicant enlistment choices. The validity of the model was established in the hold-out sample, and, to a lesser extent, in the out-of-period sample. The prototype DST provides a usable capability to evaluate incentive policies. The capabilities of the tool and the functionality of the user interface are substantial enhancements to the proof-of-concept tool that was developed in previous research.

Utilization and Dissemination of Findings:

The prototype DST and the JCM embedded in it are a valuable tool for informing the EIRB in the allocation of incentives to MOS and TOS enlistment options in order to provide the most benefit to the Army. Additional enhancements can support optimization, assess quality goals, and further improve the functionality of the DST.

The results of this research were briefed to the Army G-1 Incentives Branch on 23 October 2012 and on 25 April 2013.

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DECISION SUPPORT TOOL PROTOTYPE FOR THE ENLISTMENT INCENTIVE REVIEW BOARD

RESEARCH REQUIREMENT

Army recruitment activities must meet the continuing need for Soldiers who are qualified to perform each of the more than 100 entry-level Military Occupational Specialties (MOS) required for an effective military force. The scope of MOS offered to an applicant is filtered to reflect applicant's aptitudes assessed by the Armed Services Vocational Aptitude Battery (ASVAB) and his or her window of availability, compared to the Army's MOS aptitude and fill requirements and training seat schedules.

To encourage the applicant to choose MOS where the need is greatest at a longer term of service (TOS), the Army offers a variety of enlistment incentives. The incentives might include any of several cash bonuses, as well as educational support and repayment of educational loans. Qualification for a bonus depends on both characteristics of the applicant (e.g., aptitude), and the MOS and TOS selected. MOS incentive types, levels, amounts, and qualification criteria are determined by the Enlistment Incentive Review Board (EIRB) as part of its quarterly review process.

In order to set the levels and types of incentives that maximize their effectiveness in encouraging applicants to select high-priority MOS, while minimizing the total cost of incentives required to meet accession requirements, the EIRB needs knowledge about the process that applicants use to decide among the MOS that they are offered. Along this vein, survey research was conducted by the U.S. Military Academy (USMA) to assess which preferences of youth could be influenced by incentives (Joles, Charbonneau, & Barr, 1998; Henry, Dice, & Davis, 2001). More recent research (Diaz, Ingerick, & Sticha, 2007a, b) has developed job-choice models (JCMs) based on the decisions made by actual applicants for military service as they review the jobs that are offered to them by the Army's Recruit Quota System (REQUEST).

Most recently, Diaz, Sticha, Hogan, Mackin, and Greenston (2012) specified, estimated, and validated a JCM that represents Army applicants' MOS and TOS enlistment preferences as a function of enlistment incentives. They estimated the JCM using actual applicant choice data from the first and second quarters of fiscal year (FY) 2010. They then implemented the analysis capabilities of the JCM as a proof-of-concept decision support tool (DST) that allowed users (e.g., EIRB members) to specify incentive policy scenarios, predict applicant enlistments by MOS and TOS, calculate associated cost for each policy scenario, and compare the results across different policy scenarios. The proof-of-concept DST demonstrated the value of a tool for informing the EIRB in the allocation of incentives to MOS and TOS enlistment options.

The proof-of-concept DST had several limitations, which have become the focus of the current development effort. First, it was limited to predict enlistments for the period used to estimate the JCM. While it could be used to inform future EIRB incentive policies in times when enlistment goals are similar to those in the first and second quarters of FY 2010, a more general forecasting capability was needed. Second, the tool could only assign incentive levels to groups

or clusters of related MOS. While these clusters were constructed such that the incentive levels of MOS within a group were approximately the same during the estimation period, this constraint cannot be guaranteed in future forecasting periods. Third, the DST lacked the capability to modify the applicant supply to reflect future changes in recruiting conditions. Fourth, the DST lacked a realistic model to estimate the costs of implementing a specific set of incentives. Finally, to improve the tool's usability, the simulation-based computations need to be implemented more efficiently.

Project Objectives

The primary goal of the work described in this report is to expand the analytic features and functionalities of the DST to make it a viable tool for the EIRB in allocating incentives to meet enlistment goals and budget constraints for future quarters. This goal can be decomposed into the following specific objectives:

- Extend the JCM to apply to a larger choice set that is not filtered by applicant preferences;
- Develop methods to estimate future training requirements and applicant supply;
- Develop capability to simulate the choices of applicants in time periods other than the ones used to estimate model parameters;
- Develop and incorporate a more detailed and realistic cost model;
- Allow the user of the DST to specify incentives at the MOS level; and
- Validate the JCM and predictions against known accession requirements.

Report Organization

This report is organized as follows. First, we review how decisions regarding enlistment incentives are made and summarize previous research to develop JCMs. Second, we discuss the development and validation of a JCM that expands the choice set from the set that was considered by Diaz et al. (2012). Third, we discuss three models that were developed to enhance the capability of the DST, specifically (a) a model that simulates the choices of the applicant population, based on the incentives that are offered, (b) a model that adjusts the supply of high quality applicants for enlistment based on economic conditions, and (c) a model that estimates the cost of a specific incentive policy. Fourth, we describe the development of a DST that incorporates the models that were developed. Finally, we discuss key findings and limitations of current analysis capabilities, and provide recommendations for future research. We provide a user guide for the prototype DST as an appendix.

BACKGROUND

In order to provide useful support to decisions, it is important to understand the nature of the decisions that are made and the constraints that must be considered in making them. Consequently, we begin this section with a description of how decisions about enlistment incentives are made, based on the earlier review by Diaz et al. (2012). Following this discussion, we describe previous research that has sought to develop JCMs that describe applicants' enlistment decisions. Those models represent several approaches that were tailored to the specific problems that were being addressed. Finally, we describe the proof-of-concept DST that was developed by Diaz et al. (2012), summarizing its capabilities and limitations, and providing the motivation for the developments included in the current effort.

How Decisions about Incentives Are Made

Incentive decisions are made by the EIRB. The primary members of the EIRB are the Army G1 Incentives Branch; the Human Resources Command, Enlisted Personnel Management Division (EPMD), Accessions Management Branch (AMB); and the U.S. Army Recruiting Command (USAREC). In addition, EIRB meetings are attended by representatives from Reserve and Guard organizations. Both AMB and USAREC make recommendations regarding the level of incentives that should be offered to applicants as a function of MOS. At the EIRB meetings, these recommendations are reviewed and differences reconciled. A memorandum reflecting the results of the meeting is promulgated to establish the incentive levels for the following quarter.

Both USAREC and AMB develop spreadsheet models to assess the need for incentives and to support their recommendations regarding any changes in incentive levels that should be made. Diaz et al. (2012) reviewed these models; the results of their review are summarized in the following discussion.

USAREC MOS Ranking Model

USAREC uses an MOS ranking model to assess the need for incentives for each MOS, rank the MOS according to this need, and partition the MOS into groups to reflect the ranking. The model is constructed in an Excel™ spreadsheet. The model considers the following factors in determining the overall MOS rank:

- *Current Year Fill.* The fill for an MOS in the current fiscal year (FY) is the number of applicants who signed contracts to begin training for the specified MOS during that year. Relative fill compares the actual fill to the total requirements for that MOS and year. The current year fill aggregates several measures of fill for an MOS during the current FY, including the overall fill, the relative fill compared to other MOS, and the fill of quality accessions. The overall fill considers year-to-date accessions, future accessions in the delayed entry program (DEP), and the total contracts for the FY.
- *Past Year Fill.* This factor aggregates three measures of fill for the previous FY, including overall fill, relative fill, and the non-prior service (NPS) program.
- *AMB Priorities.* This factor represents the AMB priority category for the MOS.

- *Near Term Seats.* Seats represent the number of available openings for training in a particular MOS and time period. As the fill increases during the year, the number of open seats decreases correspondingly. This factor assesses the percentage of open seats for an MOS that occur in the next quarter.
- *Easy Sell.* This factor is a direct entry that indicates whether the MOS is substantially easier or harder to sell to an applicant than average.
- *Open Seats.* This factor represents the total number of open seats for an MOS in the current FY. Thus, it is the difference between the total number of training seats for an MOS in the current FY and the fill for that MOS in the FY.
- *Top 25 MOS.* The scale for this factor was not set in the version of the model that we reviewed. The factor is calculated based on the following factor, so it may be redundant.
- *Thirty-six critical MOS.* This factor represents the criticality of the most critical MOS.

The overall MOS score is a weighted linear combination of these factors. The relative importance of the factors in determining the overall score for an MOS (and hence its rank) depends on both the range of the scale and the weights assigned to them in the linear combination. Table 1 shows both of these items for each of the primary factors in the model. With the exception of near term open seats, which receives a weight of 0.0, the weights are similar, varying only by 10%. The ranges implied in the scale vary to a much greater extent. The first three factors—current year fill, past year fill, and AMB priorities—account for nearly 90% of the total of all ranges. In fact, the single factor representing current year fill represents about two-thirds of the total of the ranges in the MOS scores. Because the ranges vary much more than the weights (with the exception of near term seats), they are the primary determiner of the overall importance of the factors. Thus, current year fill is by far the most important factor determining the overall MOS score in the Ranking Model, as assessed by the weighted relative range.

Table 1. ***Importance of Factors in Determining MOS Score for USAREC MOS Ranking Model***

Column	Description of Factor	Weight	Minimum Scale Score	Maximum Scale Score	Range	Relative Range	Weighted Range	Weighted Relative Range
AM	Current Year Fill Factors	1.00	-113	111	224	66%	224	67%
AN	Past Year Fill Factors	1.00	-13	28	41	12%	41	12%
AP	AMB Priorities	1.10	0	36	36	11%	39.6	12%
AR	Near Term Open Seats	0.00	0	10	10	3%	0	0%
AW	Easy Sell MOS	1.10	-10	10	20	6%	22	7%
AS	Open Seats	1.05	1	6	5	1%	5.25	2%
AU	Top 25 MOS	1.05	0	0	0	0%	0	0%
AV	36 Critical MOS	1.00	0	3	3	1%	3	1%
Total					339	100%	334.85	100%

The MOS are then placed into groups according to their scores. Cut scores between groups are set and examined to ensure that the distribution of MOS into groups is reasonable. Problems with the model are addressed by changing the cut scores or the factor weights.

The MOS Ranking Model is the first step in the USAREC process in preparing for the EIRB meeting. In addition to the MOS Ranking Model, USAREC examines Recruiting Operations Center (ROC) training seat fill statistics for the year to date and for future months. It

also compares the average term of service (TOS), percentage fill, and enlistment bonus (EB) amount to Army averages to identify those jobs that may require additional incentives. Using these three information sources, USAREC recommends whether incentives should increase, decrease or remain the same for the next quarter for each MOS. It then forecasts the total EB cost for the remainder of the FY and compares this number to the forecasted cost for the previous bonus levels. The recommendations are then reconciled with those from AMB at the EIRB meeting.

AMB Recruiting Priority Model

The model used by AMB to determine the recruiting priority of MOS is similar in several respects to the USAREC MOS Ranking Model. Both develop an overall priority score that is a weighted linear combination of several factors. Like the USAREC model, the AMB Recruiting Priority Model includes factors describing MOS fill and criticality. However, the two models differ in many of the specific factors used. Because there was limited documentation of this model, it was not possible to get a precise understanding of the factors. Thus, the following list gives the names of the factors without a detailed definition.

- Analyst Projection Assistance System (APAS) Delta
- Critical MOS
- Current Priority
- Current Top 25
- Army Strategic Readiness Update (ASRU) MOS
- Recruiting History
- Year-to-date Targets
- FY Targets
- Training Constraints
- Hard Start
- Quals
- Security Clearance
- HS or Higher Ed Level
- Deployers
- TRAP
- Critical & < 100%
- Fill remaining during Window

Examination of the factor and overall scores suggested that the factors were equally weighted in determining the MOS priority. Consequently, the importance of a factor in determining the overall score depended on the range of scale values. Table 2 shows that, in general, the AMB model weights factors much more equally than the USAREC model. Note that training constraints had no variability among MOS (because no MOS were constrained), so this factor had no impact in the overall ranking of scores. However, the maximum score possible for this factor is five. Consequently, if there had been variability, the relative range of the factor would have been 2%.

Table 2. ***Importance of Factors in Determining MOS Score for AMB Recruiting Priority Model***

Column	Description of Factor	Minimum Scale Score	Maximum Scale Score	Range	Relative Range
H	APAS Delta	0	20	20	9%
I	Critical MOS	0	20	20	9%
J	Current Priority	0	20	20	9%
K	Current Top 25	0	10	10	4%
L	ASRU MOS	0	10	10	4%
M	Recruiting History	0	10	10	4%
N	Year-to-date Targets	0	30	30	13%
O	FY Targets	0	10	10	4%
P	Training Constraints	0	0	0	0%
Q	Hard Start	0	10	10	4%
R	Quals	0	10	10	4%
S	Security Clearance	0	8	8	3%
T	HS or Higher Ed Level	0	10	10	4%
U	Depolyers	0	20	20	9%
V	TRAP	5	20	15	6%
W	Critical & < 100%	0	10	10	4%
Y	Fill remaining during Window	0	20	20	9%
Total				233	100%

Modeling the Recruit Decision Process

Knowledge of how applicants weigh incentives and other factors to select their initial Army MOS is key to designing more effective and more efficient incentive strategies. In an attempt to provide this information, Joles, Charbonneau, and Barr (1998) and Henry, Dice, and Davis (2001) conducted surveys to assess the extent to which preferences of youth could be influenced by incentives. They used a market research method called choice-based conjoint analysis to estimate utility for incentive packages that consisted of MOS, TOS, EB, and loan repayment. Based on the results of the surveys, they demonstrated an optimization method to select the best incentive packages.

More recent research has looked at the decision process directly, and has built job choice models (JCMs) to represent applicants' choices among enlistment options. These JCMs were estimated based on data about the specific MOS and incentives that were presented to applicants working with guidance counselors, as well as the actual choices they made. Modeling the job-choice process occurred as an outgrowth of a field test of the Enlisted Personnel Allocation System (EPAS; Sticha, Diaz, Greenston, & McWhite, 2007). In this project, a JCM was used to simulate applicant choices, to support the implementation of an unobtrusive, simulation-based evaluation of EPAS (Diaz, Ingerick, & Sticha, 2007a).

In later research, Diaz, Ingerick, and Sticha (2007b) extended the model to consider prediction of MOS-TOS combinations, and applied the model to estimate the extent to which an increase in the maximum allowable bonus would affect enlistment in critical MOS. In response to a difficult recruiting environment, the Army obtained legislative authority to increase the EB program from $20K to $40K. The increased incentives could expand the recruiting market and

channel applicants from other MOS into ones with higher incentives. The main focus of the research was to estimate the channeling effects of expanded alternative bonus programs.

To address this question, Diaz et al. (2007b) specified, estimated, and applied a JCM using discrete choice modeling. Based on actual applicant choice data from the first quarter of FY 2005, the JCM jointly modeled applicants' decisions to join or not join the Army, and their choices of MOS training and TOS. To estimate the channeling effects of raising the bonus cap on Army accessions, the researchers applied the JCM to simulate applicants' MOS-TOS choices under both the $20K bonus and the $40K bonus. Overall, the main results of the simulations indicated that: (a) raising the bonus cap to $40K would uniformly channel applicants, particularly high quality applicants, to higher priority MOS and away from low priority ones; (b) raising the cap would attract applicants, particularly higher quality applicants, to somewhat longer TOS for higher priority MOS; and (c) the market expansion effect on the Army's higher aptitude applicant pool could further increase high quality accessions and mitigate potentially harmful channeling effects associated with raising the cap.

Diaz et al. (2012) further extended the modeling approach to address the choices of applicants in the first half of FY 2010 regarding MOS, TOS, EB, The Army College Fund (ACF), and the Student Loan Repayment Program (LRP). They specified a JCM based on a mixed multinomial logit model that related unobserved applicant characteristics to similarities among groups of MOS to provide realistic channeling effects or substitution patterns. (For instance, combat jobs are better substitutes for each other than for clerical jobs.) This model improved on earlier models so that it could be used to evaluate specific incentive configurations, not just the overall total incentive value. Using the improved specification, the effect of the full bonus and reduced bonus incentive packages on applicant choices could be directly measured. Overall, the estimated JCM fits the data well, with a pseudo R-squared (0.28) that is good given the dimension of the choice space. Furthermore, estimated parameters were shown to be very meaningful behaviorally.

Using a Recruit JCM to Assist the Decision Making Process

To demonstrate the utility of the JCM to support the development and evaluation of incentive policy, Diaz et al. (2012) developed a proof-of-concept DST that allows users to construct incentive policy scenarios by specifying the dollar values for each incentive level, the level for each MOS, and the minimum TOS for an MOS to be eligible for an incentive. A model based on a JCM then simulates applicant choices of MOS, TOS, and types of incentive based on the specified policy scenario. By running different policy scenarios, the user was able to evaluate different incentive configurations in terms of overall enlistment goals and total costs or examine their impact on specific MOS. The proof-of-concept DST included the capability to compare enlistments by MOS for any two policy scenarios. The value of the tool was demonstrated using several example incentive policies.

Although the proof-of-concept DST provided useful information to the EIRB, it was limited to predicting enlistments for the period used to estimate the JCM. While it could be used to inform future EIRB incentive policies in times when enlistment goals are similar to those in the first and second quarters of FY 2010, a more general forecasting capability is needed. The

root of this limitation is the JCM's choice set, which is based on the job lists presented to applicants by REQUEST when they choose their initial MOS. The number of MOS in these lists was filtered to reflect applicants' windows of availability and aptitude scores, and the Army's training seat schedules and MOS fill requirements. More importantly, in many cases, the list of alternative MOS was also filtered to reflect applicant preferences for certain MOS. Such preferences may be a function of the types of MOS, career fields, or incentives offered during the estimation period. In the extreme case, the list is reduced to a single MOS along with the option of not joining the Army. This means that the final job list produced by REQUEST already reflects applicant preferences, which presumably are affected by enlistment incentives in place during the estimation period and the needs of the Army during the same period. Therefore, the DST will be handicapped in two ways if the same REQUEST data are used in forecasting. First, applicant preferences partially reflected in the job list will be carried over to future forecasting periods, even if there are big changes in future incentives or the Army's needs. Second, because these partial applicant preferences were not reflected in the estimated JCM, it will not be able to fully characterize applicant preferences in future periods, even if using expanded job lists (without applicant preference filters).

The proof-of-concept DST had several other limitations that are less complicated to resolve. First, the tool could only assign incentive levels to groups or clusters of related MOS. While these clusters were constructed such that the incentive levels of MOS within a group were approximately the same during the estimation period, this constraint cannot be guaranteed in future forecasting periods. Second, the DST lacked the capability to modify the applicant supply to reflect future changes in recruiting conditions. Third, the DST lacked a realistic model to estimate the costs of implementing a specific set of incentives. Finally, to reduce the overall processing time and consequently improve the tool's usability, the simulation-based computations needed to be implemented more efficiently.

The limitations of the proof-of-concept DST provided the goals for the current research and development effort. To meet these goals, we developed a new JCM, based on an expanded set of alternative MOS opportunities that did not have the restrictions of the set of jobs provided by REQUEST. We believe that this approach makes the model more amenable to use in different time periods. To reflect the effects of economic conditions on the supply of applicants, we applied the results of econometric research to specify a model that described how the number of high quality applicants would change as a function of the recruiting environment. The model also addresses how the number of non-high quality applicants changes to compensate for changes in the number of high quality applicants. We also developed a realistic cost model that calculates the expected cost of a particular benefit, taking into account both the level of the benefit and the likelihood that a Soldier will stay in the Army long enough to qualify for the benefit. In addition, we developed a more efficient simulation procedure that greatly reduced execution time and included more realistic methods to allocate applicants to MOS to meet accession goals. Finally, we enhanced the user interface, increasing the user's ability to control requirements and manage policy scenarios, and the number of reports available. The remainder of this report describes these activities in turn.

MODELING APPLICANT JOB CHOICES

The JCM developed by Diaz et al. (2012) was estimated using job lists obtained from REQUEST transactions of applicants. The problem in this approach is that the estimated JCM does not fully describe applicant preferences and will likely produce inaccurate predicted job choice patterns in future policy forecasting periods. This section discusses this problem and key changes to the JCM so that it can better capture effects of future changes in incentive policy on applicant job choices. This section also describes key components of the JCM, including applicant choice space, utility equations, choice probability function, and estimation and fit diagnostics.

Specifying Expanded/Unbiased Applicant Job Opportunities

In the previous research, estimation of the JCM and its application to policy simulation was based on job lists obtained from applicants' REQUEST transactions. As was stated previously, the list of opportunities provided to the applicant by REQUEST is filtered by several factors, including applicant MOS preferences. In the extreme case, the job list contains a single MOS as well as the option of not joining the Army. An applicant with one or two MOS in his job list likely had expressed his preference to the counselor, who in turn applied the necessary REQUEST query filters.

There are two separate but related problems regarding the use of REQUEST job lists in the JCM. First, because the JCM is conditional on the job lists of applicants, the estimated model would not be able to capture applicant preferences that were manifested through REQUEST filters. Such estimated JCM does not fully describe applicant preferences and will produce inaccurate predicted choices when applied to forecast periods. Second, using historical REQUEST job lists for policy forecasting confounds true applicant preferences with the particular jobs offered to applicants by REQUEST in the estimation period. This will produce inaccurate results if MOS requirements and incentives offered in future forecasting period differ significantly from those in the estimation period, regardless of accuracy of the JCM.

To address the problem for estimation purposes, we reversed the effect of applicant preferences by expanding actual REQUEST job lists of applicants in the estimation data. The goal in creating expanded job list was to include MOS for which an applicant was eligible and which were available when the applicant was at the Military Entrance Processing Station (MEPS) choosing from alternative MOS. To determine which MOS were available, we used information from (a) the REQUEST transactions of applicants who showed up at the MEPS during the same week and (b) the historical U.S. Army Human Resources Command (HRC) Target Report for the same week. The Target Reports contain information regarding available seats and fill for each MOS class start-date at the start of each week. The following are the key steps used in constructing the expanded job lists.

- Step 1: We determined the likely earliest and latest MOS training class start dates that were open to each applicant by analyzing the combined REQUEST transactions of all applicants grouped by gender, education status (high school graduate, senior, and non-high school graduates), and AFQT Category (I-IIIA, IIIB or IV) during a given week. These empirically determined dates are equivalent to the Delayed Entry Porgram (DEP) policy rules that

REQUEST managers used to determine class start dates to open to applicants by gender, education status, and AFQT category.

- Step 2: We examined the class fill rates in the Target Reports by MOS and start date to determine which classes were likely open during a given week. MOS training classes that had a fill rate less than 90 percent were considered to be open during the week.
- Step 3: We then obtained a provisional list of additional MOS for a given applicant by checking which MOS training classes in the Target Reports were filled below 90 percent when the applicant was at the MEPS that have training start dates within the earliest and latest training class start dates for the applicant's gender, education status, and AFQT category profile.
- Step 4: We then checked the MOS identified in Step 3 to determine the ones for which an applicant was eligible to enlist based on aptitude area scores and gender. These MOS were added to the actual REQUEST list of the applicant to form the expanded REQUEST job list.
- Step 5: Lastly, we imputed monetary enlistment incentives that would have been available for each of the additional MOS in Step 4 using information from quarterly incentive specification memoranda.

Using the above approach we obtained expanded job lists for applicants in the first and second quarters of FY 2010 for JCM estimation. The most glaring difference between the expanded job list and actual REQUEST job list is in the percentage of applicants with 10 or fewer MOS. For example, using tabulation for the first week of February 2010, about 35% of applicants have actual REQUEST job lists with at most 10 MOS but only five percent have the same number of MOS using the expanded job list. Many of these applicants with very short actual REQUEST job lists expressed preference for specific MOS. Therefore using the expanded job list approach we obtained the desired objective of removing the effect of applicant preferences on the actual REQUEST list. The expanded job list tends to be about twice as long as the actual REQUEST list. This difference primarily occurs because REQUEST limits the number of MOS opportunities presented to applicants to 30 at a time, although applicants can exceed this limit using multiple REQUEST queries. For JCM estimation purposes, it is better to err with longer job lists to more accurately measure applicant preferences across the range of MOS in the Army.

Specifying Applicant Choice Space

In the JCM developed in previous research, Diaz et al. (2012) employed a three-dimensional choice space describing the MOS, TOS, and type of incentive (full EB, reduced EB+ACF, or none) chosen by an applicant. In that specification, MOS and TOS were the primary dimensions on which applicant enlistment choices were evaluated, while the type of incentive served as auxiliary dimension providing extra precision in the model, in particular for carrying out cost analysis. In the current research, we dropped the type of incentive dimension and specified a JCM using a choice space with only MOS and TOS dimensions for computational and practical reasons. We reduced the choice space dimension to overcome problems during initial estimation attempts using the expanded job lists with a three-dimensional

choice space. The estimation problem might have occurred because there was not enough sample information to estimate the simplified correlation structure using expanded job list, or because the assumed correlation structure itself could be less tenable with more combinations of MOS, TOS, and type of incentive in a job list of given applicant. This simplification is also desirable from a practical point of view since the Army currently does not offer ACF given the more attractive benefits of the Post-9/11 GI bill.

The choice space in the current research used the MOS and TOS subspace in the three-dimensional choice space in the previous research. Diaz et al. (2012) constructed the MOS and TOS choice subspace starting with the 36 MOS alternatives in the bonus cap research (Diaz et al., 2007b), and considered subdividing each to produce new aggregated MOS alternatives that were homogeneous relative to the current MOS incentive levels. The goal in that process was to obtain aggregated MOS alternatives that were similar with respect to the MOS incentive levels in place during the first two quarters (denoted Q1 and Q2) of FY 2010.[1] When possible, they created separate alternatives for high density MOS. Subdividing the original MOS alternatives, rather than starting anew, preserved the similarity in job content of MOS belonging to the same MOS alternative as determined in the bonus cap research. Table 3 shows the expanded MOS dimension with 55 alternatives. Note that the first three characters in the new MOS alternative labels identify the MOS alternative in the bonus cap configuration. We retained the original MOS clusters and reduced MOS clusters that were used by Diaz et al. (2007b) to identify MOS alternatives that have similar job content and likely have correlated utilities.

Diaz et al. (2012) then cross-tabulated applicants' MOS and TOS enlistment choices using the reconfigured MOS alternatives dimension to identify MOS-TOS combinations to consider for the JCM. Combinations of MOS and TOS with extremely low densities were dropped from the choice space. There were 152 MOS-TOS alternatives left after dropping extremely low density (MOS, TOS) whose combined total accounted for less than 0.3 percent of the data.

[1] Reconfiguring the MOS alternative dimension also involved matching the new MOS alphanumeric labels to the old MOS alphanumeric labels in place at the time of the bonus cap research.

Table 3. ***MOS Alternative Configuration and Clusters***

Alternative ID	Alternative Label	Cluster*	Reduced Cluster	MOS
1	11X1	1	1	11X
2	13F1	2	1	13F
3	FA11	2	1	13D
4	FA12	2	1	13B, 13M
5	FA21	2	1	13R
6	FA22	2	1	13P, 13S
7	FA23	2	1	13T
8	AD11	2	1	14J
9	AD12	2	1	14E, 14S, 14T
10	AV11	7	4	15J
11	AV12	7	4	15B, 15D, 15E, 15F, 15G, 15H, 15N, 15R, 15S, 15T, 15U, 15Y
12	AV21	7	4	15P, 15Q
13	18X1	1	1	18X
14	19D1	1	1	19D
15	19K1	1	1	19K
16	EN11	10	7	12Y
17	EN12	10	7	12D, 12K, 12M, 12N, 12R, 12T, 12V, 12W, 91E, 91L
18	EN21	10	7	12B, 12C
19	SI11	14	10	25R
20	SI12	14	10	25B, 25M, 25V
21	SI21	3	2	25P, 25S
22	SI22	3	2	25Q
23	SI23	3	2	25F, 25N, 25U
24	SI24	3	2	25C, 25L
25	PA11	4	3	46Q, 46R
26	PA12	4	3	37F
27	LE11	4	3	31B, 31E
28	EL11	6	4	94A, 94D, 94E, 94F, 94M, 94S, 94Y
29	EL12	6	4	68A, 91C, 94H, 94L, 94P, 94R, 94T
30	EL21	6	4	68A
31	AX11	8	5	91C
32	AX12	8	5	94H
33	AX13	8	5	94L, 94P, 94R
34	AM11	11	4	94T, 91G, 91K
35	52D1	5	4	91D
36	VM11	5	4	91M
37	VM12	5	4	91H, 91J, 91P
38	VM21	5	4	91A, 91B
39	74D1	13	9	74D
40	TR11	9	6	88H, 88K, 88L, 88N

Table 3. ***(continued)***

Alternative				
ID	Label	Cluster*	Reduced Cluster	MOS
41	88M1	9	6	88M
42	89D1	4	3	89D
43	89B1	9	6	89A, 89B
44	MD11	12	8	68K
45	MD12	12	8	68D, 68E, 68G, 68H, 68J, 68M, 68P, 68Q, 68R, 68S, 68T, 68X
46	MD13	12	8	68W
47	92F1	9	6	92F
48	92G1	9	6	92G, 92R
49	SL11	9	6	92A, 92L, 92M, 92S, 92W, 92Y
50	IN11	3	2	35W
51	IN12	3	2	35H
52	IN13	3	2	35N
53	IN14	3	2	35F, 35G, 35S
54	HI11	3	2	35M
55	15W1	7	4	15W

Note. MOS-Cluster Titles: 1=Close Combat; 2=Non Line-of-Sight Fire; 3=Surveillance, Intelligence, and Communications; 4=Security and Civil Affairs; 5=Mechanical Maintenance Repair; 6= Electronics Maintenance Repair; 7=Aircraft Maintenance Repair; 8=Administration; 9=Logistics/Supply Support; 10=Heavy Equipment Operator; 11=Craftworker; 12=Medical Care, Health, and Well-Being; 13=Skilled Science Technician; 14=Media Specialist

A limitation of the 55 MOS alternative configuration is that in future periods, individual MOS that were grouped into one of the 55 MOS alternatives would likely have different levels of incentives. Consequently, the DST will not be able to assign incentive levels to individual MOS if using this configuration. To address this limitation, we estimated the JCM in two steps. First, we estimated the JCM using the 55 MOS alternatives to estimate effects of incentives and applicant characteristics and TOS-specific constants. Second, holding these parameters fixed at their estimated values, we then estimated the MOS-specific constants using a JCM with MOS dimension expanded to individual MOS. We then used the individual MOS-specific constants from the second estimation, along with TOS-specific constants and estimated effects of incentives and applicant characteristics in the DST.

Some applicants must also choose between the full EB and reduced EB+ACF/LRP type of incentives for some choice of MOS and TOS. As mentioned earlier, we did not formally include this dimension in the current JCM, which can only directly describe applicant MOS and TOS choices. Knowing how applicants choose between full EB and reduced EB+ACF/LRP incentives is needed in estimating total cost of an incentive policy. To disaggregate (MOS,TOS) choice probabilities into full EB and reduced EB with ACF or LRP, we used the percent distribution of applicants' choice of different types of incentives observed from the data. This procedure is discussed in more detail later in the report.

Table 4 summarizes the distribution of the types of incentives chosen by applicants for each of two sets of incentives that appear in REQUEST job lists of applicants in FY2010 Q1 and

Q2. Incentive Package "A" means that the full cash bonus (EB-only) incentive and the reduced cash bonus (EB+ACF/LRP) or ACF/LRP-only incentives are available in the REQUEST list. As indicated in quarter incentive specification memoranda, either EB+ACF/LRP or ACF/LRP-only is always offered as a substitute for EB-only incentive. Incentive Package "B" means that only the ACF/LRP incentive is available in the REQUEST list.[2] The table reports the frequency and percentage distribution of different incentives within incentive packages A and B by TOS. The results are reported for all applicants combined and by education status. Note that there are some cases in which an applicant was awarded an EB, even though no opportunity containing an EB was included in the REQUEST list. Since the details of the opportunities presented by REQUEST and the incentives chosen by the applicant come from different files, this discrepancy may reflect an error in one of the files. Alternatively, the date of the choice may differ from the date of the REQUEST query. Finally, since the REQUEST list does not necessarily represent all of the MOS for which an applicant is qualified, the applicant may have chosen an opportunity that was not included in the list.

Table 4 shows that, overall, applicants are relatively less likely to choose the reduced cash bonus in incentive package A when signing up for longer TOS (5 or 6) compared to shorter TOS (3 or 4). While preference for the full cash bonus is consistent across education status categories, it is less pronounced for applicants with some college or higher education than with seniors or high school graduates. In other words, for applicants with some college or higher education the ACF/LRP component in the reduced cash bonus package retains its value, even with increasing full cash bonus from TOS=3 to TOS=6. This education status-type of incentive interaction is not surprising as applicants with college or higher education tend to have future college education to fund or existing student loans to repay. To a lesser extent, seniors also appear to value the ACF incentive more compared to high school graduates. Note that Table 4 also shows that only a fractional percentage of applicants were recorded to have declined an enlistment cash bonus that was available in their chosen (MOS,TOS) enlistment alternative.

[2] Not shown in the table is Package type "C" which means that only the full cash bonus was available in the job list. This is inconsistent with quarterly incentive specification memoranda and very likely is a data error as evidenced by its negligible percentage.

Table 4***. Applicants' Chosen Incentives by Type of Incentive Package***

Education Status	Type of Chosen Incentive	TOS=3				TOS=4				TOS=5				TOS=6			
		Package A		Package B		Package A		Package B		Package A		Package B		Package A		Package B	
		N	Pct	N	Pct	N	Pct	N	Pct	N	Pct	N	Pct	N	Pct	N	Pct
Overall	EB	398	52.6	23	0.5	1,561	64.0	13	0.5	779	69.9	0	0.0	1,267	85.9	2	0.6
	EB - ACF	204	27.0	7	0.1	238	9.8	2	0.1	57	5.1	1	1.2	91	6.2	1	0.3
	EB - LRP	58	7.7	1	0.0	44	1.8	0	0.0	47	4.2	0	0.0	38	2.6	0	0.0
	ACF	40	5.3	3,538	69.7	547	22.4	2,182	82.3	146	13.1	76	93.8	74	5.0	280	80.2
	LRP	34	4.5	484	9.5	40	1.6	158	6.0	77	6.9	2	2.5	3	0.2	20	5.7
	None	22	2.9	1,021	20.1	9	0.4	295	11.1	9	0.8	2	2.5	2	0.1	46	13.2
	TOTAL	*756*	*100.0*	*5,074*	*100.0*	*2,439*	*100.0*	*2,650*	*100.0*	*1,115*	*100.0*	*81*	*100.0*	*1,475*	*100.0*	*349*	*100.0*
College+	EB	69	36.7	3	0.3	206	53.9	3	0.5	187	53.7	0	0.0	192	73.0	0	0.0
	EB - ACF	40	21.3	0	0.0	29	7.6	0	0.0	9	2.6	0	0.0	21	8.0	1	1.5
	EB - LRP	46	24.5	1	0.1	31	8.1	0	0.0	40	11.5	0	0.0	30	11.4	0	0.0
	ACF	8	4.3	579	51.1	80	20.9	426	66.6	41	11.8	11	84.6	18	6.8	44	64.7
	LRP	23	12.2	387	34.1	33	8.6	128	20.0	68	19.5	1	7.7	2	0.8	14	20.6
	None	2	1.1	164	14.5	3	0.8	83	13.0	3	0.9	1	7.7	0	0.0	9	13.2
	TOTAL	*188*	*100.0*	*1,134*	*100.0*	*382*	*100.0*	*640*	*100.0*	*348*	*100.0*	*13*	*100.0*	*263*	*100.0*	*68*	*100.0*
HSDG	EB	287	57.5	20	0.6	1,116	67.3	7	0.4	512	79.0	0	0.0	928	89.9	1	0.5
	EB - ACF	147	29.5	7	0.2	171	10.3	2	0.1	38	5.9	1	1.9	54	5.2	0	0.0
	EB - LRP	12	2.4	0	0.0	13	0.8	0	0.0	7	1.1	0	0.0	8	0.8	0	0.0
	ACF	23	4.6	2,450	74.1	346	20.9	1,364	86.5	76	11.7	50	94.3	39	3.8	182	83.9
	LRP	11	2.2	97	2.9	7	0.4	29	1.8	9	1.4	1	1.9	1	0.1	6	2.8
	None	19	3.8	733	22.2	5	0.3	174	11.0	6	0.9	1	1.9	2	0.2	28	12.9
	TOTAL	*499*	*100.0*	*3,307*	*100.0*	*1,658*	*100.0*	*1,576*	*100.0*	*648*	*100.0*	*53*	*100.0*	*1,032*	*100.0*	*217*	*100.0*
Senior	EB	42	60.9	0	0.0	239	59.9	3	0.7	80	67.2	0	0.0	147	81.7	1	1.6
	EB - ACF	17	24.6	0	0.0	38	9.5	0	0.0	10	8.4	0	0.0	16	8.9	0	0.0
	EB - LRP	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
	ACF	9	13.0	509	80.4	121	30.3	392	90.3	29	24.4	15	100.0	17	9.4	54	84.4
	LRP	0	0.0	0	0.0	0	0.0	1	0.2	0	0.0	0	0.0	0	0.0	0	0.0
	None	1	1.4	124	19.6	1	0.3	38	8.8	0	0.0	0	0.0	0	0.0	9	14.1
	TOTAL	*69*	*100.0*	*633*	*100.0*	*399*	*100.0*	*434*	*100.0*	*119*	*100.0*	*15*	*100.0*	*180*	*100.0*	*64*	*100.0*

Note. EB = Enlistment Bonus, EB - ACF = Enlistment Bonus with Army College Fund, EB - LRP = Enlistment Bonus with Loan Repayment Program, ACF = Army College Fund, LRP = Loan Repayment Program. Package A indicates that Enlistment Bonus is available to applicant; Package B indicates that Enlistment Bonus is not included in the REQUEST list.

Specifying Applicant Choice Model

We used discrete choice modeling to relate applicant enlistment choices to the attributes of the enlistment alternatives and characteristics of the applicants. Specifically we employed the mixed multinomial logit (MMNL) model (Train, 1986; Ben-Akiva & Lerman, 1985; Green 2000) given the strong similarity among MOS alternatives. This modeling approach will produce more realistic MOS substitution pattern or channeling effect compared to the simpler multinomial logit model, which assumes that the alternatives are uncorrelated (i.e. independence from irrelevant alternatives assumption). In the following discussion we specify the utility equations for the enlistment alternatives and present the JCM probability function that relates applicant enlistment choices to applicant characteristics and alternative attributes.

While the utility or value that an applicant places on an enlistment alternative will only be known to the applicant, it can generally be modeled using a utility equation. This equation represents the value of an alternative to an applicant as a function of observable characteristics of the applicant and attributes of the alternative. It includes a systematic utility and error components, which are shown below using the general form of the utility equation:

$$U_{i,m,t}(X,Z) = V_{i,m,t}(X,Z) + F_{i,m,t} + E_{i,m,t}$$

The term $V_{i,m,t}(X,Z)$ represents the systematic component of utility, which relates the alternative with MOS *m* and TOS *t* to the characteristics (Z) of the *i*th applicant and attributes (X) of the enlistment alternative. The term $F_{i,m,t}$ represents an error component included to model the similarities of MOS alternatives, and is presumed to be related to unobserved characteristics of applicants. The term $E_{i,m,t}$ represents an unobserved utility or error term that is unique to an alternative. From a researcher's point of view, $V_{i,m,t}(X,Z)$ is the observable or predictable part of an applicant's choice behavior and $F_{i,m,t} + E_{i,m,t}$ is the unobservable part of choice behavior. The specific forms of these components are described in detail below.

Systematic Utility

We first specify the systematic utility as a function of monetary incentives, applicant demographics, and aptitude scores. For the enlistment alternative associated with MOS=*m*, and TOS= *t*, the systematic utility involves characteristics of applicants and attributes of alternatives represented by Z and X variables defined in Table 5. The variables listed in Table 5 were entered as separate predictors or combined to form interaction terms in the systematic utility equation. Interactions are described in more detail below. The dollar values of cash bonuses are shown in Table 6 by incentive level and TOS.

Table 5. ***List of Alternative Attributes and Applicant Characteristics Used in the JCM***

Name	Description
MOS/TOS-Specific Incentives:	
$X_{EB1,i,m,t}$	Enlistment Bonus (EB) available to the *i*th applicant for the *m*th MOS and *t* years of TOS. This is Army's primary monetary incentive tool and is offered in increasing dollar amounts by priority level of an MOS.
$X_{HG,i,m}$	High Grad (HG) bonus available to the *i*th applicant for the *m*th MOS. This cash bonus is available to applicants with varying levels of college education (at least 30 or 60 college credit hours, and AB or associate degrees).
$X_{SB,i,m}$	Seasonal Bonus (SB) available to the *i*th applicant for the *m*th MOS. The SB incentive is used to encourage enlistment to near term training classes. It is offered at three levels depending on how close training start date is at the time of transaction at the MEPS.
$X_{RB,i,m}$	Ranger Bonus (RB) available to the *i*th applicant for the *m*th MOS.
$X_{DEB,i,m}$	Deferred Enlistment Bonus (DEB) available to the *i*th applicant for the *m*th MOS.
Demographic Variables:	
$Z_{sexM,i}$	Sex indicator variable (1=Male, 0=Female)
$Z_{edC,i}$	Indicator variable for education status beyond high school graduate (i.e., at least some college semester hours).
$Z_{edG,i}$	Indicator variable for high school graduate education status.
$Z_{edS,i}$	Indicator variable for high school senior education status.
$Z_{edN,i}$	Indicator variable for not high school graduate education status.
$Z_{13A,i}$	Indicator variable for AFQT Category I-IIIIA.
$Z_{AA,i,m}$	Score of the applicant for the Aptitude Area for the *m*th MOS.

Table 6. ***Bonus Dollar Amounts by Priority Level and Type***

Level	Type	TOS=2	TOS=3	TOS=4	TOS=5	TOS=6
FY 2010 Q1 (October 2009)						
1	EB		7K	10K	15K	20K
	EB+ACF	+150	4K+350	5K+650	8K+850	10K+950
	EB+LRP		4K	5K	8K	10K
2	EB		4K	7K	10K	15K
	EB+ACF	+150	2K+350	4K+650	5K+850	8K+950
	EB+LRP		2K	4K	5K	8K
3	EB		2K	3K	6K	8K
	ACF	+150	+350	+650	+850	+950
4	EB			1K	3K	6K
	ACF	+150	+350	+650	+850	+950
5	ACF	+150	+350	+650	+850	+950
FY 2010 Q2 (December 2009)						
1	EB		4K	6K	12K	20K
	EB+ACF	+150	2K+350	3K+650	6K+850	10K+950
	EB+LRP		2K	3K	6K	10K
2	EB		1K	4K	6K	12K
	EB+ACF	+150	1K+350	2K+650	3K+850	6K+950
	EB+LRP		1K	2K	3K	6K
3	EB			1K	4K	6K
	ACF	+150	+350	+650	+850	+950
4	EB				1K	4K
	ACF	+150	+350	+650	+850	+950
5	ACF	+150	+350	+650	+850	+950

Note. TOS = Term of Service, EB = Enlistment Bonus, ACF = Army College Fund, LRP = Loan Repayment Program. The FY 2010 Q2 bonuses were effective on 1 December 2009, a month before the beginning of the fiscal quarter.

The full expression for the systematic utility of the enlistment alternative associated with MOS=*m*, and TOS= *t* is given by:

$$
\begin{aligned}
V_{i,m,t}(X,Z) = {} & A_{M,m} + G_{sexM,c(m)} Z_{sexM,i} + G_{13A,c(m)} Z_{13A,i} + G_{edS,c(m)} Z_{edS,i} + G_{edC,c(m)} Z_{edC,i} \\
& + A_{T,t} + G_{sexM,t} Z_{sexM,i} + G_{13A,t} Z_{13A,i} + G_{edS,t} Z_{edS,i} + G_{edC,t} Z_{edC,i} \\
& + G_{AA} Z_{AA,i,m} \\
& + B_{HG} X_{HG,i,m} + B_{SB} X_{SB,i,m} + B_{AB} X_{AB,i,m} + B_{RB} X_{RB,i,m} + B_{DEB} X_{DEB,i,m} \\
& + B_{EBg1} X_{EBg1,i,m,t,k} + B_{EBs1} X_{EBs1,i,m,t,k} + B_{EBc1} X_{EBc1,i,m,t,k} \\
& + B_{BC} \max\left(0, X_{TB,i,m,t} - C_t\right)
\end{aligned}
$$

The parameters in the utility equation labeled “A” represent alternative-specific constants; parameters labeled “G” represents the effects of applicant characteristics in the form of alternative-subgroup interactions; and parameters labeled “B” represent the effects of monetary incentives and MOS aptitude area scores of applicants.

The first three lines in the systematic utility relate the characteristics of the applicants to the MOS and TOS dimensions of enlistment alternatives. The first line specifies an MOS-specific constant for each alternative and MOS alternative-subgroup interactions based on applicant gender, AFQT category, and education status. To obtain a parsimonious model, the MOS alternative-subgroup interactions were specified to be constant within groups of MOS with similar job requirements based on the 10 reduced clusters. The MOS interaction terms in the first line essentially relate observed characteristics of applicants (gender, education status, and AFQT category) to qualitative attributes of MOS based on job requirements. The subscript notation *c(m)* denotes the MOS cluster to which the *m*th MOS alternative belongs. The second line in the systematic utility specifies a TOS-specific constant for each alternative and TOS-subgroup interactions based on applicant gender, AFQT category, and education status. The third line describes the effect of applicant aptitude area score on MOS preferences; it measures the extent to which applicant preferences and aptitudes match.

In the first three lines separate education status interactions were specified for all three main education subgroups, namely, some college or higher, high school graduates, and seniors.[3] We used the 10 reduced MOS clusters to specify the MOS alternative-subgroup interactions, making the alternative-subgroup interactions consistent with the error components (also specified using the 10 MOS clusters), in turn facilitating interpretation. For example, the error components can be interpreted more readily as unobserved applicant MOS biases not accounted by applicant subgroups.

The fourth line in the utility expression represents a component of systematic utility explained by monetary incentives that can vary across the MOS-dimension of the alternative space but not specific to MOS levels. There are two incentives, seasonal bonus (SB) and Airborne bonus (AB), that were not offered during the enlistment period covered by the data but included in the utility expression for completeness.

The fifth line, which corresponds to the part of utility that is most relevant to the EIRB, measures the effect of full cash bonus package (EB-only) by education status. This line represents the effect of the full cash bonus. The variables $X_{EBg1,i,m,t,k}$, $X_{EBs1,i,m,t,k}$, and $X_{EBc1,i,m,t,k}$ respectively correspond to the interaction between the full bonus amount and education status indicator variables for high school graduate, senior, and some college or higher. For example, for seniors, the interaction was computed as: $X_{EBs1,i,m,t,k} = X_{EB1,i,m,t,k} \times Z_{edS,i}$. Note that missing are lines in the previous JCM measuring the effect of reduced cash bonus package (EB+ACF or ACF-only). Using only full EB to measure attractiveness of an MOS incentive is reasonable because the reduced EB amount is correlated with full EB amount while ACF is constant across MOS for a given TOS.

The last line is the bonus cap term that ensures that the total utility reflects the total bonus constraint specified in the quarterly incentive specification memoranda by TOS. We did not

[3] Only small fraction of applicants did not obtain a high school diploma. These applicants were grouped with high school graduates when specifying alternative-education status interactions.

record any applicant with total possible bonus ($X_{TB,i,m,t,k}$) that exceeded the bonus cap C_t from the REQUEST transactions data.[4]

The systematic utility for the decision not to join the Army only comprises alternative specific constants and subgroup interactions. It differs from the utility equation specified in the bonus cap research in that there are no socio-economic variables. The full equation is given by:

$$V_{i,999}(X,Z) = A_{M,999} + G_{sexM,999}Z_{sexM,i} + G_{13A,999}Z_{13A,i} + G_{edS,999}Z_{edS,i} + G_{edC,999}Z_{edC,i}$$

Unobserved Utility

As mentioned earlier, we modeled the unobserved utility as $F_{i,m,t} + E_{i,m,t,}$, where $F_{i,m,t}$ is an error component that is shared by MOS alternatives with similar job requirements and $E_{i,m,t}$ is a random error that is unique to an alternative. Again, we used the 10 MOS clusters to identify groups of MOS alternatives that have similar job requirements. In specifying the error component, we make the assumption that shared unobserved utilities are related to unobserved characteristics of applicants.

We specified the following distributional assumptions to completely define unobserved utility. We specified $F_{i,m,t} = \sigma_{c(m)}\xi_{i,c(m)}$, where $\xi_{i,c(m)}$ is a standard normal random variable common to all alternatives in the MOS cluster indexed by *c(m)* and $\sigma_{c(m)}$ is the standard deviation of the error component. In this specification, the random variables $\xi_{i,c(m)}$ represent unobserved characteristics of applicants (e.g., preference for certain types of jobs), and $\sigma_{c(m)}$ is a scale parameter to be estimated from data. The random variables $\xi_{i,c(m)}$ are assumed to be independent across MOS clusters and applicants. On the other hand, the random utilities $E_{i,m,t}$ are specified to be independently distributed across applicants and alternatives as standard Gumbel distribution with mode zero and variance $\pi^2/6$. The random variables $E_{i,m,t}$ and $\xi_{i,c(m)}$ are specified to be independent within and across clusters.

The above error component specification for the unobserved utility induces a positive correlation between utilities within an MOS cluster. Behaviorally, for an applicant, this means alternatives within a given MOS cluster are better substitutes for each other than alternatives in other MOS clusters. This substitution pattern will produce more realistic channeling effects and is important in forecasting applications of the JCM. For the researcher, these correlations simply arise from the covariances of the shared unobserved utilities. For alternatives belonging to the same MOS cluster $c(m)$ this correlation is given by:

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[4] Note that this does not mean that it was not possible for an individual to receive the maximum advertised bonus during Q1 and Q2 of FY 2010.

$$\rho_{c(m)} = corr\left(U_{i,m,t}, U_{i,m',t',}\right)$$
$$= \frac{\operatorname{cov}\left(F_{i,m,t} + E_{i,m,t}, F_{i,m',t'} + E_{i,m',t'}\right)}{\operatorname{var}\left(F_{i,m,t} + E_{i,m,t}\right)\operatorname{var}\left(F_{i,m',t'} + E_{i,m',t'}\right)}$$
$$= \frac{\sigma^2_{c(m)}}{\sigma^2_{c(m)} + \pi^2/6}.$$

In specifying the error component above, we modeled (a) the correlation between alternatives with similar MOS, regardless of TOS and (b) the correlation between alternatives with the same MOS but different TOS to be equal; that is, $corr\left(U_{i,m,t}, U_{i,m',t}\right)$, $corr\left(U_{i,m,t'}, U_{i,m',t'}\right)$, and $corr\left(U_{i,m,t}, U_{i,m,t'}\right)$ are all equal to $\rho_{c(m)}$. Modeling these three correlations to be equal was a simplifying assumption. Note that in the previous JCM these three types of correlation were also specified to be equal to the correlation between alternatives in a cluster with the same MOS and TOS but different types of incentive.

Lastly, we also specified an unobservable component, $F_{i,999}$, in the utility of the alternative for not joining the Army. This additional component represents extra variance not accounted for in the utility for not joining the Army (e.g., effect of civilian pay). In our previous effort (Diaz et al., 2012), we used this component to account for unobserved preference related to number (single vs. multiple) of MOS in the applicants' REQUEST job lists, which is no longer needed because the current JCM uses expanded applicant job lists.

Job Choice Probability

We specify below the probability function that relates the systematic and unobserved utilities to an applicant's enlistment choice. Let A_i denote the set of all (*m,t*) enlistment alternatives available to the *i*th applicant. The probability that applicant *i* chooses alternative (*m',t'*) is given by the mixed multinomial logit probability model:

$$P_i(m',t') = \int_{\xi} \frac{\exp\left(V_{i,m',t'}(X,Z) + \sigma_{c(m)}\xi_{i,c(m')}\right)}{\exp\left(V_{i,999}(X,Z) + \sigma_{999}\xi_{i,999}\right) + \sum_{(m,t)\in A_i}\exp\left(V_{i,m,t}(X,Z) + \sigma_{c(m)}\xi_{i,c(m)}\right)} d\overline{\xi_i}$$

The multiple integration above is taken over the vector of standard normal variables $\overline{\xi_i} = \left(\xi_{i,c(1)}, \ldots, \xi_{i,c(10)}, \xi_{i,999}\right)$, where V is the systematic utility expression defined earlier. Note that the form of the integrand is that of a multinomial logit probability model that includes unobserved applicant characteristic $\xi_{i,c(m')}$ as a predictor. For JCM estimation and forecasting, the integration is approximated using random draws from the multivariate normal distribution (Train, 2003). In this research, we are primarily interested in applicants' predicted choices of MOS. The probability corresponding to this choice is obtained by simply summing the two-dimensional probability across TOS, $P_i(m) = \sum_t P_i(m,t)$.

JCM Estimation

Method

We estimated the JCM parameters using the maximum simulated likelihood method implemented in the Biogeme software (Bierlaire, 2003). This method uses simulation to approximate the MMNL probability model above when evaluating the likelihood during estimation. Altogether, the estimation involved an 11-dimensional multivariate normal distribution for each applicant, 10 normal random variables $\xi_{i,c(m)}$ (*m*=1,…,10) for the MOS cluster error components and one variable, $\xi_{i,999}$, for the utility of not joining the Army. We used 200 Halton draws (quasi random numbers) from this distribution for each applicant during estimation.

Estimation Data

We used the expanded job list for applicants in the first and second quarters of FY 2010. These expanded job lists were constructed as described earlier, starting from actual REQUEST job list of applicants. As was done in the previous research, we estimated a common JCM for the first two quarters combined instead of separate models by quarter for the following reasons. First, we only had about fifty percent of the REQUEST transactions for Q1. Second, unlike in the bonus cap Research, monetary incentives were offered less frequently with a limited range; combining EIRB incentive levels from Q1 and Q2 increased the variance of the monetary incentives. Third, for forecasting applications, one estimated JCM should be sufficient, because the estimation data will eventually be reweighted to have the same applicant distribution (i.e. gender, AFQT category, education status subgroups) as the target quarter. Combining Q1 and Q2 REQUEST data produces a larger estimation sample for each MOS and applicant subgroup than one quarter of data.

There were a total of 60,403 applicants in the FY 2010 Q1 and Q2 data after carrying out data checks and diagnostics to ensure consistency between job lists and reservation records. Of this total, 25,481 were classified as accessions (individuals with reservation) and the remaining 34,922 as non-accessions (individuals without reservation). Note that the non-accession rate was 57.8%, more than twice the non-accession rate of 27.7% in the bonus cap Research. Because the total number of accessions appear consistent with prior FY data, we presume that the high percentage of applicants who did not make a reservation could be related to the poor job market and/or the new system in place, in which recruiters in the field can enter temporary reservations in addition to the usual reservations entered by counselors at the MEPS. We were not able to obtain additional information that could have been used to verify the relatively high non-accession percentage.

We employed the adjustments to FY 2010 Q1 and Q2 data in the previous research JCM to obtain a non-accession rate that was more in line with previous FYs. The adjustment was carried out by taking a random sample of 10,000 from the 34,922 non-accessions in the REQUEST data, producing an adjusted total of 35,481 applicants, with 28.2% (n=10,000) non-accessions and 71.2% (n=25,481) accessions. From this adjusted REQUEST data, we obtained an estimation sample of 8,160 applicants of which 7,160 were accessions and 1,000 non-

accessions. To ensure that all MOS-TOS combinations were adequately represented in the estimation, we used choice-based sampling to select the 7,160 accessions. This was carried out by grouping the applicants according to their chosen MOS and TOS, and then under-sampling the larger groups and over-sampling the smaller groups. During estimation, each applicant was weighted by the reciprocal of the sampling rate of his/her chosen MOS and TOS. The remaining 27,321 applicants (18,321 are accession and 9,000 non-accessions) were used to form the hold-out sample for evaluating JCM prediction accuracy. The weight used for each applicant in the hold-out was equal to the reciprocal of the probability of his/her non-inclusion in the estimation sample.

Estimation Results

Estimating the parameters of the JCM was computationally intensive given the large sample size and number of utility equations. As mentioned earlier we estimated the JCM in two steps. In the first step, we ran Biogeme's MMNL estimation method using the JCM specification described earlier using 55 MOS alternatives until convergence. The estimated JCM parameters and their corresponding standard errors (S.E.) and t-statistics are shown in Table 7. These standard errors and t-statistics are based on robust variance-covariance matrix estimates (Bierlaire, 2003). Bolded t-statistics are significant at the .05 level. Where standard error and t-statistic values are blank, the corresponding parameters were fixed at zero. In the second step, we fixed the estimated effects of incentives and applicant characteristics and TOS-specific constants and estimated 128 individual MOS level constants using a JCM with MOS dimension expanded to individual MOS. These 128 MOS constants, shown in **Error! Reference source not found.**, were used in the DST along with TOS constants, incentive effects and applicant characteristic interactions in Table 7.

Interpreting the JCM Parameters

Direct interpretation of the JCM parameters is not straightforward. Ultimately applicant preferences relate to the JCM parameters through the differences in systematic utilities of enlistment alternatives. Interpretation is also made complicated by the interactions between MOS and TOS alternatives and applicant demographics, as well as with unobserved applicant characteristics underlying the error components. The following discussion focuses on the JCM parameters that describe the relative preferences of applicants in relation to the incentive levels.

We first describe the MOS and TOS constants that characterize the average relative preferences of applicants for different enlistment alternatives. For interpretation, we will use estimates presented in Table 7 that were obtained in the first step of the estimation. The estimated values for the MOS constants correspond to the parameters prefixed by "AM" in Table 7. Note that these constants are expressed as differences relative to MOS 11X , which was fixed at zero. The estimated values for MOS alternative-specific constants ranged from about -7.4 to 4.2. The middle 50 percent of MOS constants ranged from -2.9 to -0.39, while the middle 80 percent ranged from -6.1 to 0.8. As discussed below, these differences between estimated MOS alternative constants were within the range of the direct effects of the EB/ACF incentives. The estimated values for the TOS constants correspond to the parameters prefixed by "AT" in

Table 7. ***JCM Parameter Estimates Using 28% Non-Accession***

Parameter	Estimate	S.E.	t-stat	Parameter	Estimate	S.E.	t-stat
MOS-Specific Constants				*MOS-Specific Constants (cont'd)*			
AM01	0			*AM49*	0.6485	0.2846	**2.28**
AM02	-2.0375	0.0874	**-23.31**	*AM50*	-4.7564	2.3142	**-2.06**
AM03	-2.7616	0.1056	**-26.16**	*AM51*	-7.3858	2.2246	**-3.32**
AM04	-1.5000	0.0699	**-21.47**	*AM52*	-6.3429	2.2259	**-2.85**
AM05	-4.4715	0.1872	**-23.88**	*AM53*	-5.4027	2.2157	**-2.44**
AM06	-3.6595	0.1641	**-22.30**	*AM54*	-6.1409	2.2485	**-2.73**
AM07	-3.2470	0.1916	**-16.95**	*AM55*	-0.0668	0.4080	-0.16
AM08	-2.2344	0.1035	**-21.58**	*AM999*	-12.3692	7.3331	-1.69
AM09	-2.4153	0.0944	**-25.59**				
AM10	0.4057	0.3652	1.11	*TOS-Specific Constants*			
AM11	1.0794	0.3161	**3.41**	*AT3*	0.0000		
AM12	-2.7561	0.3585	**-7.69**	*AT4*	-1.3021	0.0852	**-15.29**
AM13	0.8020	0.1128	**7.11**	*AT5*	-2.8302	0.1936	**-14.62**
AM14	-0.3946	0.0983	**-4.01**	*AT6*	-3.6532	0.1924	**-18.99**
AM15	-1.8040	0.1048	**-17.21**				
AM16	-1.6727	0.5591	**-2.99**	*MOS Cluster-Subgroup Interactions*			
AM17	-1.0810	0.5298	**-2.04**	*GM13A01*	0.0000		
AM18	-1.2556	0.5062	**-2.48**	*GM13A02*	1.1287	0.7576	1.49
AM19	-0.3746	0.5718	-0.66	*GM13A03*	0.0926	0.2255	0.41
AM20	1.2951	0.5051	**2.56**	*GM13A04*	-0.0602	0.0915	-0.66
AM21	-6.2466	2.2276	**-2.80**	*GM13A05*	0.1997	0.2184	0.91
AM22	-5.8478	2.2375	**-2.61**	*GM13A06*	-0.6943	0.0924	**-7.51**
AM23	-5.6817	2.2398	**-2.54**	*GM13A07*	-0.2499	0.1312	-1.9
AM24	-7.3332	2.2476	**-3.26**	*GM13A08*	0.8138	0.2874	**2.83**
AM27	-1.3906	0.8085	-1.72	*GM13A09*	0.5157	0.2459	**2.1**
AM28	-1.0630	0.3323	**-3.20**	*GM13A10*	-0.7119	0.3277	**-2.17**
AM29	-1.8253	0.3307	**-5.52**	*GM13A999*	5.0804	1.8657	**2.72**
AM30	-0.6663	0.3803	-1.75	*GMedC01*	0.0000		
AM31	4.1838	0.5929	**7.06**	*GMedC02*	0.7820	0.3019	**2.59**
AM32	-2.9140	0.4746	**-6.14**	*GMedC03*	0.0375	0.2391	0.16
AM33	-1.8008	0.4328	**-4.16**	*GMedC04*	0.1302	0.1174	1.11
AM34	-1.8405	0.3354	**-5.49**	*GMedC05*	-0.0609	0.2784	-0.22
AM35	-0.8960	0.3176	**-2.82**	*GMedC06*	0.3763	0.1158	**3.25**
AM36	-2.4212	0.3574	**-6.77**	*GMedC07*	-0.0232	0.1654	-0.14
AM37	-0.8902	0.3219	**-2.76**	*GMedC08*	0.2349	0.1484	1.58
AM38	-0.2799	0.3138	-0.89	*GMedC09*	0.4710	0.2679	1.76
AM39	-1.0026	0.4574	**-2.19**	*GMedC10*	-0.0941	0.3791	-0.25
AM40	-0.4322	0.3063	-1.41	*GMedC999*	9.7746	4.9073	**1.99**
AM41	0.7854	0.2826	**2.78**	*GMedS01*	0.0000		
AM42	-1.2981	0.7695	-1.69	*GMedS02*	1.0237	0.2790	**3.67**
AM43	-0.5004	0.3144	-1.59	*GMedS03*	1.6645	0.3134	**5.31**
AM44	-0.4483	0.4408	-1.02	*GMedS04*	1.2329	0.1245	**9.91**
AM45	-1.7447	0.3616	**-4.82**	*GMedS05*	2.4432	0.2971	**8.22**
AM46	1.8086	0.4070	**4.44**	*GMedS06*	0.3390	0.1559	**2.17**
AM47	-0.1474	0.2932	-0.50	*GMedS07*	0.8591	0.2094	**4.1**
AM48	0.5622	0.2862	1.96	*GMedS08*	-0.0544	0.2463	-0.22

Table 7. ***(continued)***

Parameter	Estimate	S.E.	t-stat	Parameter	Estimate	S.E.	t-stat
MOS Cluster-Subgroup Interactions (cont'd)				*Incentives Not Dependent on MOS Level*			
GMedS09	0.6722	0.3534	1.90	*Bhg*	-0.0196	0.0468	-0.42
GMedS10	2.5443	0.2952	**8.62**	*Brb*	0.4680	0.0385	**12.16**
GMedS999	14.3878	5.1246	**2.81**	*Bdeb*	7.4948	0.3199	**23.43**
GMsex01	0.0000						
GMsex02	0.0000			*EB-Only Incentive*			
GMsex03	-2.0842	0.3974	**-5.24**	*BebC1*	0.1086	0.0139	**7.82**
GMsex04	-1.5666	0.3156	**-4.96**	*BebG1*	0.1169	0.0100	**11.67**
GMsex05	-2.0567	0.3614	**-5.69**	*BebS1*	0.0258	0.0208	1.24
GMsex06	-2.4803	0.2950	**-8.41**				
GMsex07	-1.0461	0.3370	**-3.10**	*S.D. of Error Components*			
GMsex08	-2.1843	0.3707	**-5.89**	*SF01*	0.5510	0.3339	1.65
GMsex09	-2.8279	0.3791	**-7.46**	*SF02*	-4.3319	1.6004	**-2.71**
GMsex10	-2.1849	0.4421	**-4.94**	*SF03*	1.7458	0.6533	**2.67**
GMsex999	-6.4243	2.6748	**-2.40**	*SF04*	0.2024	0.3244	0.62
				SF05	-0.9286	0.3591	**-2.59**
TOS-Subgroup Interactions				*SF06*	-0.0567	0.1260	-0.45
GT13A3	0.0000			*SF07*	1.2065	0.4253	**2.84**
GT13A4	1.1243	0.0655	**17.16**	*SF08*	-0.1617	1.2634	-0.13
GT13A5	1.2423	0.1528	**8.13**	*SF09*	-0.8383	0.3760	**-2.23**
GT13A6	1.6091	0.1694	**9.50**	*SF10*	0.2160	0.2855	0.76
GTedC3	0.0000			*SG999*	21.8367	10.5749	**2.06**
GTedC4	0.0766	0.0808	0.95				
GTedC5	0.2875	0.1306	**2.20**				
GTedC6	-0.1601	0.1547	-1.04				
GTedS3	0.0000						
GTedS4	0.6359	0.0847	**7.51**				
GTedS5	0.2888	0.1746	1.65				
GTedS6	0.9161	0.1670	**5.48**				
GTsex3	0.0000						
GTsex4	-0.5577	0.0809	**-6.90**				
GTsex5	-0.6459	0.1432	**-4.51**				
GTsex6	-0.1436	0.1497	-0.96				
MOS AA and Incentives							
Baa	1.1193	0.1355	**8.26**				

Note. MOS specific constants refer to the MOS alternative groups defined in Table 3. E.g., AM05 refers to alternative 05, which is MOS 13R. MOS cluster-subgroup interactions refer to the 10 reduced clusters shown in Table 3, combined with applicant characteristics. E.g., GMedC02 represents the component of utility for opportunities in MOS Cluster 02 to applicants with some college (educational category C). Similarly, TOS-subgroup interactions combine TOS alternatives, in years, with applicant characteristics. E.g., GTedS3 represents the component of utility for opportunities with TOS of 3 years for applicants who are seniors (educational category S).

Table 8. ***Individual Level MOS Constants***

MOS	Constant	MOS	Constant	MOS	Constant
11X	0	*25L*	-8.4059	*89B*	0.8542
12B	-1.1213	*25M*	1.8378	*89D*	-1.2111
12C	-3.3001	*25N*	-5.8619	*91A*	-1.9015
12D	-0.3098	*25P*	-7.8514	*91B*	-0.3446
12K	-3.9481	*25Q*	-5.8633	*91C*	-2.0916
12M	-3.2038	*25R*	-0.2829	*91D*	-0.8824
12N	-1.8128	*25S*	-5.9149	*91E*	-2.7737
12R	-3.4156	*25U*	-7.1473	*91F*	-1.5004
12T	-0.8444	*25V*	0.4090	*91G*	-2.4376
12V	-3.2038	*27D*	4.2659	*91H*	-1.4408
12W	-2.2198	*31B*	-1.5441	*91J*	-2.2702
12Y	-1.6186	*31E*	-1.7040	*91K*	-2.7802
13B	-1.6876	*35F*	-5.3495	*91L*	-2.7465
13D	-2.7448	*35G*	-7.1649	*91M*	-2.4028
13F	-2.0156	*35H*	-7.3613	*91P*	-2.2019
13M	-3.0401	*35M*	-0.4580	*92A*	0.0118
13P	-3.6166	*35N*	-6.2542	*92F*	-0.2037
13R	-4.4401	*35S*	-7.9998	*92G*	0.3149
13S	-3.6595	*35T*	-0.5575	*92L*	0.6485
13T	-3.2171	*35W*	-4.6574	*92M*	0.6485
14E	-2.8194	*36B*	-3.1935	*92R*	-0.7535
14J	-2.1912	*42A*	-0.7225	*92S*	-1.1122
14S	-3.3639	*42F*	-2.3893	*92W*	-1.2414
14T	-3.2025	*56M*	-2.9804	*92Y*	-0.4642
15B	-0.7642	*68A*	-1.8253	*94A*	-3.3100
15D	-0.7471	*68D*	-1.7447	*94D*	-2.6274
15E	3.8520	*68E*	-3.3630	*94E*	-1.1023
15F	-1.1515	*68G*	-3.6746	*94F*	-2.2287
15G	0.5404	*68H*	-1.7447	*94H*	-1.8523
15H	0.1312	*68J*	-3.6746	*94L*	-1.8523
15J	0.5153	*68K*	-0.3889	*94M*	-1.7527
15N	0.0078	*68M*	-3.6746	*94P*	-2.4474
15P	-2.9860	*68P*	-3.6746	*94R*	-1.8523
15Q	0.2477	*68Q*	-1.7447	*94S*	-1.2587
15R	-0.4645	*68R*	-1.2229	*94T*	-1.8523
15S	-0.7471	*68S*	-3.6746	*94Y*	-1.0630
15T	1.6819	*68T*	-2.7779	*NACC*	-12.3056
15U	1.0796	*68W*	1.8985		
15W	-0.0151	*68X*	0.0234		
15Y	-0.7036	*74D*	-0.9967		
18X	0.8657	*88H*	-0.7103		
19D	-0.3805	*88K*	-0.2358		
19K	-1.7787	*88L*	-0.0360		
25B	1.2606	*88M*	0.7414		
25C	-7.6901	*88N*	-1.3115		
25F	-6.5189	*89A*	-0.1756		

Table 7. The TOS constants were normalized relative to TOS=3, which was fixed at zero. The estimated constants were negative and decreasing from TOS=4 to TOS=6, indicating lower overall preferences for longer TOS for given MOS and incentive. The average systematic utilities for TOS=4, 5, and 6 decreased by 1.30, 2.83, and 3.65 when compared to TOS=3. As with differences in MOS preferences, the average relative preferences across TOS were also within the range of the effects of EB/ACF incentives and could be managed by their application.

Next we describe parameters that capture the effects of EB incentives on applicant enlistment preferences and illustrate the potential of the full EB incentive for managing the preferences of applicants with at least some college education using a numerical example. The estimated coefficients for the full EB incentive for applicants with at least some college education is given by *BebC1*=0.1086 in Table 7, representing a change of 0.1086 in utility for every thousand dollars in EB incentive. This estimated coefficient is statistically significant (t-stat=7.82, $p < .001$), with a magnitude that can meaningfully increase/decrease applicants' preferences for (MOS,TOS) enlistment alternatives.

To demonstrate the potential of the full EB incentive to manage MOS preferences of applicants with some college education, we calculated the change in systematic utility obtained by raising the EB incentive to level 1 from each of the lower levels in Q1 of FY 2010. Table 9 summarizes resulting increases in systematic utility by incentive level and TOS. The column "Amt" shows the amount of enlistment bonus for each level in thousands, while the column "Util Diff" shows the increase in systematic utility if the bonus is raised to level 1. Changes in systematic utility were computed by multiplying the difference in bonus amount between incentive levels by 0.1086, the estimated change in systematic utility for a thousand dollar increase in EB. As can be seen in Table 9, raising the EB dollar amount from level 3 or lower to level 1 substantially increases the systematic utility relative to differences in MOS constants. For example, the increase in systematic utility from raising the EB from none to level 1 when the TOS is 6 years (2.17) is nearly as great as the range among the middle 50% of MOS constants (2.5 between -2.9 and -0.39). In other words, the differences in average MOS preferences are within the range of the effects of the EB incentives, especially for higher TOS.

Table 9. ***Change in Systematic Utility by Raising Enlistment Bonus Incentives to Level 1 from Lower Levels (2, 3, 4, None) Using FY 2010 Q1 Incentive Levels***

	TOS=3		TOS=4		TOS=5		TOS=6	
Level	Amt	Util Diff	Amt	Util Diff	Amt	Util Diff	Amt	Util Diff
1	7	0.00	10	0.00	15	0.00	20	0.00
2	4	0.33	7	0.33	10	0.54	15	0.54
3	2	0.54	3	0.76	6	0.98	8	1.30
4	0	0.76	1	0.98	3	1.30	6	1.52
None	0	0.76	0	1.09	0	1.63	0	2.17

Note: Amt is the amount of the Enlistment Bonus in thousands. The incentive levels are defined in Table 6.

We also demonstrate the potential of the full EB incentive for managing preferences of applicants with at least some college education across TOS. Table 10 shows the differences in average preferences for each of the higher TOS (4, 5, and 6) compared to TOS=3, taking into

account the effects of EB at each level. For each row (incentive level), the differences in average systematic utility across TOS are given under the column "Util Diff". Note that differences shown along the first row, which corresponds to no incentive (Level=None), are simply the estimated TOS constants. The remaining rows show differences in average preferences between each of the higher TOS and TOS=3 for incentive levels 1 through 4, after adjusting for the effect of the amount of bonus at the given incentive level (row). Adjustments were computed by multiplying the differences in bonus amounts between the higher TOS and TOS=3 for the given incentive level by *BebC1*=0. 1086.

Table 10 shows that bonuses can substantially increase the overall preference for higher TOS. For example, the average preferences for TOS=5 and 6 are lower than the preference for TOS=3 by 2.83 and 3.65, respectively, when no incentives are offered. However, average preference for TOS=5 and 6 are lower than preference for TOS=3 by only 1.96 and 2.24, respectively, under incentive level 1, and by 2.18 and 2.46, respectively, under incentive level 2. The corresponding improvement in relative preferences for TOS=5 and 6 over TOS=3 are 0.87 and 1.41 under level 1, and 0.65 and 1.20 under level 2. These improvements are substantial when compared to the standard deviation of the difference in the utilities of any two enlistment alternatives for a given applicant, which is equal to 1.81.[5] In general, a difference between two alternatives of three utiles is large, with lower than 5% probability of preferring the lesser attractive alternative between the two alternatives. For instance, if no incentives were offered with an MOS the probability is only about 2.5% that an applicant would prefer a TOS of six years over a TOS of three years (with a difference of 3.65 utiles). But if EB dollar amounts at incentive level 1 were offered the probability would increase by almost fourfold to 9.6% that the same applicant would prefer six years over three years of TOS (with a difference of 2.24 utiles).

Table 10. ***Differences in Average Systematic Utility Across TOS Adjusted for Effects of Enlistment Bonus by Incentive Level for FY 2010 Q1***

	TOS=3		TOS=4		TOS=5		TOS=6	
Level	Amt	Util Diff	Amt	Util Diff	Amt	Util Diff	Amt	Util Diff
None	0	0.00	0	-1.30	0	-2.83	0	-3.65
1	7	0.00	10	-0.98	15	-1.96	20	-2.24
2	4	0.00	7	-0.98	10	-2.18	15	-2.46
3	2	0.00	3	-1.19	6	-2.40	8	-3.00
4	0	0.00	1	-1.19	3	-2.50	6	-3.00

Note: Amt is the amount of the Enlistment Bonus in thousands. The incentive levels are defined in Table 6.

The preceding discussion demonstrated the potential of the full EB incentive for managing the preferences of applicants with at least some college education. The full EB incentive has comparable effect on the preferences of high school graduates with an estimated coefficient of *BebG1*=0.1169. The effect of full EB on preferences of senior applicants is somewhat low with a not statistically positive estimated coefficient of *BebS1*=0.0258.

[5] This is computed as the square root of two times $\pi^2/6$, the variance of the unobserved utility $E_{i,m,t,k}$.

In sum, the EB/ACF/LRP incentives can be effective in managing applicant preferences for (MOS, TOS) enlistment alternatives. The estimated effects of the incentives differ across education status of applicants. Estimated channeling effects depend on the amounts of and differences in incentives across incentive levels and TOS. While most of the observations above are “well known” or “expected,” the JCM provides a way for quantifying the effects objectively.

The estimated effects of other components of the JCM are similar to those observed in the previous JCM. More detailed discussions of these effects were discussed by Diaz et al. (2012). For example, the *Baa* coefficient is estimated to be 1.1193, which is statistically significant, indicating that applicants tend to prefer MOS for which they have higher aptitude. Overall, large differences between estimated interaction constants mean that relative preferences for MOS and TOS (i.e., differences in their systematic utilities) will differ substantially from one subgroup to another. Lastly six error components corresponding to unobserved applicant characteristics have estimated standard deviations that are statistically significant, indicating that enlistment alternatives have unequal variance (heteroscedasticity) across reduced MOS clusters and are inter-correlated within clusters.

Model Fit Diagnostics and Validation

Model Fit

The estimated JCM obtained from the first step in which all parameters were estimated simultaneously has a pseudo R-squared of 0.32 which is substantial given the dimension of the choice space. This is also better than the pseudo-R^2 of the JCM in the previous research, which was 0.28. This suggests that using expanded applicant job lists in the current JCM, even while excluding effects of reduced EB+ACF incentives, improved prediction of applicant enlistment choices compared to the JCM in the previous research, which employed the actual (and likely filtered) REQUEST job list.

In-Sample Validation

To further evaluate model fit, we compared the expected choices of applicants based on the estimated JCM to their actual choices. This comparison was conducted separately using the JCM estimation sample (n = 8,160) and the hold-out validation sample (n = 27,321). Comparisons were only carried out on the MOS alternative dimension and only for the overall sample. Table 11 shows the results for the estimation sample while Table 12 shows the results for the hold-out sample. Each row in these tables compares the observed and expected number of accessions and the corresponding percentage for each MOS. The column “Diff. N.” reports the difference between observed and expected number of accessions, while the column “Ratio N.” reports the ratio of expected accessions relative to observed accessions. In addition to MOS fills, the table also reports the observed and expected amount of enlistment bonus (“Obs. EB” and “Exp. EB”) for each MOS. “Observed bonus” is simply the average amount of EB computed across applicants who chose the MOS for the given row. The “expected bonus” for each MOS was computed as a weighted average across all applicants (whether or not they chose the MOS), using the JCM probabilities as weights.

As evidenced by Table 11, the estimated number of accessions/non-accessions closely matched the observed accessions/non-accessions for most MOS alternatives in the estimation sample. This is to be expected for the estimation sample, especially with a JCM that includes MOS-specific constants. The few MOS alternatives with somewhat sizeable differences tended to have small accessions. As shown in Table 12, there was also a strong correspondence between the observed and expected number of accessions/non-accessions for most MOS in the hold-out sample. Similarly, relatively large differences tended to occur for MOS with small accessions. To summarize model fit, we computed the root mean square prediction error (RMSPE) by taking the square root of the average of the squared differences between expected and observed number of accessions. For the estimation sample RMSPE is 19.36 while for hold-out sample RMSPE is 24.51. As with pseudo-R^2, these compare favorably relative to RMSPE computed in the previous research using actual REQUEST job list, which are 32.58 and 41.44, respectively.

Table 11. ***Estimation Sample JCM Fit Diagnostics by MOS Alternative***

Alt. ID	Label	Obs. N	Exp. N	Diff. N	Ratio N	Obs. Pct.	Exp. Pct.	Obs. EB	Exp. EB
1	11X1	5500	5503.8	-3.8	1.00	15.501	15.512	0.97	0.98
2	13F1	526	529.5	-3.5	1.01	1.482	1.492	1.06	1.25
3	FA11	350	349.8	0.2	1.00	0.986	0.986	3.41	3.52
4	FA12	931	926.0	5.0	0.99	2.624	2.610	0.00	0.00
5	FA21	46	46.6	-0.6	1.01	0.130	0.131	1.51	2.31
6	FA22	99	99.4	-0.4	1.00	0.279	0.280	0.75	0.65
7	FA23	52	51.3	0.7	0.99	0.147	0.145	0.00	0.00
8	AD11	569	544.4	24.6	0.96	1.604	1.534	9.69	8.50
9	AD12	443	443.8	-0.8	1.00	1.249	1.251	0.28	0.23
10	AV11	59	56.4	2.6	0.96	0.166	0.159	4.53	4.23
11	AV12	731	695.0	36.0	0.95	2.060	1.959	0.00	0.00
12	AV21	56	56.5	-0.5	1.01	0.158	0.159	0.00	0.00
13	18X1	377	377.9	-0.9	1.00	1.063	1.065	2.14	3.14
14	19D1	551	552.2	-1.2	1.00	1.553	1.556	0.00	0.00
15	19K1	374	378.2	-4.2	1.01	1.054	1.066	0.31	0.41
16	EN11	72	70.3	1.7	0.98	0.203	0.198	0.44	1.18
17	EN12	824	815.8	8.2	0.99	2.322	2.299	0.00	0.00
18	EN21	722	739.8	-17.8	1.02	2.035	2.085	0.00	0.00
19	SI11	23	23.0	0.0	1.00	0.065	0.065	4.43	5.39
20	SI12	191	199.9	-8.9	1.05	0.538	0.563	0.00	0.00
21	SI21	232	248.1	-16.1	1.07	0.654	0.699	12.42	10.18
22	SI22	910	931.0	-21.0	1.02	2.565	2.624	4.21	4.11
23	SI23	430	457.1	-27.1	1.06	1.212	1.288	1.05	1.35
24	SI24	261	266.4	-5.4	1.02	0.736	0.751	0.00	0.00
27	LE11	434	434.5	-0.5	1.00	1.223	1.225	0.00	0.00
28	EL11	264	269.0	-5.0	1.02	0.744	0.758	1.99	1.23
29	EL12	178	188.2	-10.2	1.06	0.502	0.530	0.00	0.01
30	EL21	36	36.4	-0.4	1.01	0.101	0.102	0.00	0.00
31	AX11	128	106.3	21.7	0.83	0.361	0.299	1.85	1.66
32	AX12	93	91.1	1.9	0.98	0.262	0.257	0.17	0.18
33	AX13	301	298.9	2.1	0.99	0.848	0.843	0.00	0.00
34	AM11	155	155.4	-0.4	1.00	0.437	0.438	0.00	0.00
35	52D1	541	550.3	-9.3	1.02	1.525	1.551	0.16	0.23
36	VM11	51	48.4	2.6	0.95	0.144	0.137	0.18	0.05
37	VM12	421	420.4	0.6	1.00	1.187	1.185	0.00	0.00
38	VM21	753	741.5	11.5	0.98	2.122	2.090	0.00	0.00
39	74D1	299	325.6	-26.6	1.09	0.843	0.918	0.00	0.00
40	TR11	223	229.4	-6.4	1.03	0.629	0.647	0.00	0.00

Note: Obs.N=observed accessions; Exp.N=expected accessions; Dff.N=observed minus expected accessions; Ratio N=expected divided by observed accessions; Obs.Pct.=observed accessions divided by total applicants; Exp.Pct.=expected accession divided by total applicants; Obs.EB=observed EB amount; Exp.EB=expected EB amount

Table 11. ***(continued)***

Alt. ID	Label	Obs. N	Exp. N	Diff. N	Ratio N	Obs. Pct.	Exp. Pct.	Obs. EB	Exp. EB
41	88M1	1088	1104.8	-16.8	1.02	3.066	3.114	0.19	0.24
42	89D1	367	367.5	-0.5	1.00	1.034	1.036	12.58	12.45
43	89B1	154	155.6	-1.6	1.01	0.434	0.438	0.00	0.00
44	MD11	36	39.4	-3.4	1.10	0.101	0.111	2.13	3.07
45	MD12	207	208.1	-1.1	1.01	0.583	0.586	0.00	0.00
46	MD13	1354	1376.8	-22.8	1.02	3.816	3.880	0.00	0.00
47	92F1	464	476.3	-12.3	1.03	1.308	1.342	0.23	0.22
48	92G1	833	837.8	-4.8	1.01	2.348	2.361	0.00	0.00
49	SL11	1283	1222.7	60.3	0.95	3.616	3.446	0.00	0.00
50	IN11	303	208.9	94.1	0.69	0.854	0.589	15.16	16.99
51	IN12	52	51.9	0.1	1.00	0.147	0.146	2.42	3.87
52	IN13	224	230.6	-6.6	1.03	0.631	0.650	0.62	0.62
53	IN14	600	630.7	-30.7	1.05	1.691	1.778	0.05	0.07
54	HI11	273	269.3	3.7	0.99	0.769	0.759	0.00	0.00
55	15W1	37	50.8	-13.8	1.37	0.104	0.143	1.26	0.60
999	NACC	10000	9992.3	7.7	1.00	28.184	28.162	0.00	0.00

Note: Obs.N=observed accessions; Exp.N=expected accessions; Dff.N=observed minus expected accessions; Ratio N=expected divided by observed accessions; Obs.Pct.=observed accessions divided by total applicants; Exp.Pct.=expected accession divided by total applicants; Obs.EB=observed EB amount; Exp.EB=expected EB amount.

Table 12***. Hold-Out (Validation) Sample JCM Fit Diagnostics by MOS Alternative***

Alt. ID	Label	Obs. N	Exp. N	Diff. N	Ratio N	Obs. Pct.	Exp. Pct.	Obs. EB	Exp. EB
1	11X1	5500	5568.3	-68.3	1.01	15.502	15.694	0.97	0.96
2	13F1	526	529.5	-3.5	1.01	1.483	1.492	1.11	1.22
3	FA11	350	351.0	-1.0	1.00	0.986	0.989	3.31	3.46
4	FA12	931	932.7	-1.7	1.00	2.624	2.629	0.00	0.00
5	FA21	46	46.5	-0.5	1.01	0.130	0.131	2.35	2.27
6	FA22	99	99.1	-0.1	1.00	0.279	0.279	0.66	0.62
7	FA23	52	51.1	0.9	0.98	0.147	0.144	0.00	0.00
8	AD11	569	527.7	41.3	0.93	1.604	1.487	9.78	8.30
9	AD12	443	433.5	9.5	0.98	1.249	1.222	0.30	0.22
10	AV11	59	59.4	-0.4	1.01	0.166	0.167	3.72	4.05
11	AV12	731	684.5	46.5	0.94	2.060	1.929	0.00	0.00
12	AV21	56	55.9	0.1	1.00	0.158	0.157	0.00	0.00
13	18X1	377	370.5	6.5	0.98	1.063	1.044	2.02	3.07
14	19D1	551	563.3	-12.3	1.02	1.553	1.588	0.00	0.00
15	19K1	374	384.0	-10.0	1.03	1.054	1.082	0.30	0.41
16	EN11	72	69.6	2.4	0.97	0.203	0.196	0.43	1.16
17	EN12	824	802.8	21.2	0.97	2.322	2.263	0.00	0.00
18	EN21	722	742.4	-20.4	1.03	2.035	2.092	0.00	0.00
19	SI11	23	21.7	1.3	0.95	0.065	0.061	4.87	5.25
20	SI12	191	194.5	-3.5	1.02	0.538	0.548	0.00	0.00
21	SI21	232	247.3	-15.3	1.07	0.654	0.697	11.97	10.00
22	SI22	910	929.7	-19.7	1.02	2.565	2.620	4.15	4.02
23	SI23	430	454.7	-24.7	1.06	1.212	1.282	1.06	1.33
24	SI24	261	260.9	0.1	1.00	0.736	0.735	0.00	0.00
27	LE11	434	436.5	-2.5	1.01	1.223	1.230	0.00	0.00
28	EL11	264	272.4	-8.4	1.03	0.744	0.768	1.96	1.14
29	EL12	178	174.6	3.4	0.98	0.502	0.492	0.00	0.00
30	EL21	36	38.1	-2.1	1.06	0.101	0.107	0.00	0.00
31	AX11	128	113.2	14.8	0.88	0.361	0.319	1.96	1.82
32	AX12	93	90.1	2.9	0.97	0.262	0.254	0.17	0.18
33	AX13	301	287.8	13.2	0.96	0.848	0.811	0.00	0.00
34	AM11	155	157.1	-2.1	1.01	0.437	0.443	0.00	0.00
35	52D1	541	551.4	-10.4	1.02	1.525	1.554	0.13	0.22
36	VM11	51	47.8	3.2	0.94	0.144	0.135	0.13	0.05
37	VM12	421	415.4	5.6	0.99	1.187	1.171	0.00	0.00
38	VM21	753	755.2	-2.2	1.00	2.122	2.129	0.00	0.00
39	74D1	299	312.3	-13.3	1.04	0.843	0.880	0.00	0.00
40	TR11	223	218.6	4.4	0.98	0.629	0.616	0.00	0.00

Note: Obs.N=observed accessions; Exp.N=expected accessions; Dff.N=observed minus expected accessions; Ratio N=expected divided by observed accessions; Obs.Pct.=observed accessions divided by total applicants; Exp.Pct.=expected accession divided by total applicants; Obs.EB=observed EB amount; Exp.EB=expected EB amount.

Table 12. ***(continued)***

Alt. ID	Label	Obs. N	Exp. N	Diff. N	Ratio N	Obs. Pct.	Exp. Pct.	Obs. EB	Exp. EB
41	88M1	1088	1116.7	-28.7	1.03	3.067	3.148	0.19	0.23
42	89D1	367	365.9	1.1	1.00	1.034	1.031	12.60	12.27
43	89B1	154	155.0	-1.0	1.01	0.434	0.437	0.00	0.00
44	MD11	36	38.0	-2.0	1.06	0.101	0.107	1.98	2.99
45	MD12	207	206.9	0.1	1.00	0.583	0.583	0.00	0.00
46	MD13	1354	1409.4	-55.4	1.04	3.816	3.972	0.00	0.00
47	92F1	464	461.7	2.3	0.99	1.308	1.301	0.27	0.23
48	92G1	833	851.1	-18.1	1.02	2.348	2.399	0.00	0.00
49	SL11	1283	1206.2	76.8	0.94	3.616	3.400	0.00	0.00
50	IN11	303	208.0	95.0	0.69	0.854	0.586	15.19	16.60
51	IN12	52	50.9	1.1	0.98	0.147	0.144	3.37	3.86
52	IN13	224	234.8	-10.8	1.05	0.631	0.662	0.69	0.60
53	IN14	600	629.6	-29.6	1.05	1.691	1.774	0.01	0.07
54	HI11	273	265.6	7.4	0.97	0.769	0.749	0.00	0.00
55	15W1	37	46.2	-9.2	1.25	0.104	0.130	1.85	0.46
999	NACC	9999	9983.0	15.9	1.00	28.182	28.137	0.00	0.00

Note: Obs.N=observed accessions; Exp.N=expected accessions; Dff.N=observed minus expected accessions; Ratio N=expected divided by observed accessions; Obs.Pct.=observed accessions divided by total applicants; Exp.Pct.=expected accession divided by total applicants; Obs.EB=observed EB amount; Exp.EB=expected EB amount.

Out-Of-Period Validation

We also applied the estimated model to predict job choice outcomes in the third quarter of FY 2010, which is outside of the period used in estimating the JCM, and examined accuracy of prediction. The results are shown in Table 13. Compared to in-sample results shown in Table 11 and Table 12, differences between expected and actual accessions are substantially larger. There were a number of MOS with actual accessions that are more than twice expected accessions. RMSPE computed from FY 2010 Q3 is 143.9, compared with estimation and hold-out sample RMSPEs of 19.36 and 24.51 from FY 2010 Q1-Q2 period.

The large discrepancy in Table 13 could be due to the inability of the expanded job list to accurately represent the demand or requirement in FY 2010 Q3. Regardless of applicant preferences, REQUEST would open MOS with higher requirements more often than those with lower requirements. Once they are filled, MOS with lower requirements will no longer show up in REQUEST. Our expanded applicant job list algorithm, on the other hand, tends to make more MOS available to applicants. By design we preferred to make more rather than fewer MOS available to applicants to allow the JCM to better capture channeling effects of incentives. Additionally, our forecasting simulation design turns off an MOS once its pre-determined demand is met, as is done in REQUEST, so the application of the JCM in the DST will not produce the discrepancies in Table 13. In conclusion, while out-of-period predictive accuracy is not great, the JCM remains very useful for capturing MOS channeling effects of incentive given the way it is employed in our simulation design.

Table 13.***Out-of-Period Sample JCM Fit Diagnostics by MOS Alternative***

Alt. ID	Label	Obs. N	Exp. N	Diff. N	Ratio N	Obs. Pct.	Exp. Pct.	Obs. EB	Exp. EB
1	11X1	3117	2624.7	492.3	0.84	17.686	14.893	0.73	0.73
2	13F1	248	231.4	16.6	0.93	1.407	1.313	3.66	3.10
3	FA11	133	127.0	6.0	0.95	0.755	0.721	2.49	2.86
4	FA12	352	361.8	-9.8	1.03	1.997	2.053	0.00	0.00
5	FA21	28	17.6	10.4	0.63	0.159	0.100	3.89	3.33
6	FA22	39	37.2	1.8	0.95	0.221	0.211	0.72	0.93
7	FA23	8	5.1	2.9	0.64	0.045	0.029	0.00	0.00
8	AD11	24	183.1	-159.1	7.63	0.136	1.039	11.75	8.80
9	AD12	169	173.9	-4.9	1.03	0.959	0.987	0.33	0.31
10	AV11	66	19.1	46.9	0.29	0.374	0.108	0.36	0.11
11	AV12	268	279.9	-11.9	1.04	1.521	1.588	0.00	0.00
12	AV21	90	26.6	63.4	0.30	0.511	0.151	0.00	0.00
13	18X1	236	196.7	39.3	0.83	1.339	1.116	1.85	2.70
14	19D1	723	607.2	115.8	0.84	4.102	3.445	0.00	0.00
15	19K1	252	229.5	22.5	0.91	1.430	1.302	0.19	0.25
16	EN11	0	0.0	0.0	0.00	0.000	0.000	0.00	1.02
17	EN12	229	338.8	-109.8	1.48	1.299	1.922	0.00	0.00
18	EN21	264	185.9	78.1	0.70	1.498	1.055	0.00	0.00
19	SI11	34	10.1	23.9	0.30	0.193	0.057	8.82	9.75
20	SI12	172	260.6	-88.6	1.51	0.976	1.479	0.00	0.00
21	SI21	119	121.7	-2.7	1.02	0.675	0.691	12.40	12.69
22	SI22	90	315.4	-225.4	3.50	0.511	1.790	3.78	3.61
23	SI23	308	172.1	135.9	0.56	1.748	0.976	0.56	1.18
24	SI24	66	100.4	-34.4	1.52	0.374	0.569	0.00	0.00
27	LE11	424	284.6	139.4	0.67	2.406	1.615	0.00	0.00
28	EL11	162	89.6	72.4	0.55	0.919	0.509	3.88	1.93
29	EL12	75	70.5	4.5	0.94	0.426	0.400	0.00	0.00
30	EL21	2	14.0	-12.0	6.99	0.011	0.079	0.00	0.00
31	AX11	30	37.4	-7.4	1.25	0.170	0.212	4.07	4.02
32	AX12	23	46.8	-23.8	2.03	0.131	0.265	0.00	0.00
33	AX13	249	185.1	63.9	0.74	1.413	1.051	0.00	0.00
34	AM11	61	59.3	1.7	0.97	0.346	0.337	0.00	0.00
35	52D1	85	173.9	-88.9	2.05	0.482	0.987	0.01	0.01
36	VM11	6	19.2	-13.2	3.21	0.034	0.109	0.00	0.00
37	VM12	120	154.2	-34.2	1.28	0.681	0.875	0.00	0.00
38	VM21	725	321.7	403.3	0.44	4.114	1.825	0.00	0.00
39	74D1	145	140.5	4.5	0.97	0.823	0.797	0.00	0.00
40	TR11	66	107.7	-41.7	1.63	0.374	0.611	0.00	0.00

Note: Obs.N=observed accessions; Exp.N=expected accessions; Dff.N=observed minus expected accessions; Ratio N=expected divided by observed accessions; Obs.Pct.=observed accessions divided by total applicants; Exp.Pct.=expected accession divided by total applicants; Obs.EB=observed EB amount; Exp.EB=expected EB amount.

Table 13. ***(continued)***

Alt. ID	Label	Obs. N	Exp. N	Diff. N	Ratio N	Obs. Pct.	Exp. Pct.	Obs. EB	Exp. EB
41	88M1	471	516.1	-45.1	1.10	2.672	2.928	0.21	0.17
42	89D1	282	162.7	119.3	0.58	1.600	0.923	11.60	12.07
43	89B1	84	101.9	-17.9	1.21	0.477	0.578	0.00	0.00
44	MD11	12	53.8	-41.8	4.48	0.068	0.305	0.00	0.00
45	MD12	120	96.4	23.6	0.80	0.681	0.547	0.00	0.00
46	MD13	747	1229.8	-482.8	1.65	4.239	6.978	0.00	0.00
47	92F1	307	217.5	89.5	0.71	1.742	1.234	0.27	0.46
48	92G1	313	387.9	-74.9	1.24	1.776	2.201	0.00	0.00
49	SL11	853	613.6	239.4	0.72	4.840	3.482	0.00	0.00
50	IN11	79	69.5	9.5	0.88	0.448	0.394	14.68	16.37
51	IN12	104	124.0	-20.0	1.19	0.590	0.704	0.06	0.00
52	IN13	340	322.4	17.6	0.95	1.929	1.829	0.42	0.15
53	IN14	100	269.5	-169.5	2.70	0.567	1.529	0.00	0.00
54	HI11	19	189.0	-170.0	9.95	0.108	1.072	1.53	0.39
55	15W1	4585	4940.3	-354.8	1.08	26.018	28.031	0.00	0.00
999	NACC	10000	9885.3	114.7	0.99	28.210	27.887	0.00	0.00

Note: Obs.N=observed accessions; Exp.N=expected accessions; Dff.N=observed minus expected accessions; Ratio N=expected divided by observed accessions; Obs.Pct.=observed accessions divided by total applicants; Exp.Pct.=expected accession divided by total applicants; Obs.EB=observed EB amount; Exp.EB=expected EB amount.

DEVELOPMENT OF MODELS FOR DECISION SUPPORT

Although the JCM provides the mechanism for predicting the choice of MOS and TOS as a function of incentives, the three modules described in the following discussion allow the JCM to be implemented as a part of the DST and allow the DST to be applied to situations that differ from the conditions under which the JCM was estimated.

Market Effects on the Number and Mix of Army Enlisted Applicants

The EIRB simulation is based on a fixed number and quality distribution of applicants. The number of high quality applicants is defined here to be those applicants who have at least a high school diploma and who have scored in the upper half on the Armed Forces Qualification Test (AFQT) distribution. That is, it includes all AFQT I-IIIA high school diploma graduates (i.e., Tier 1 Applicants). The proportion of such applicants among the total applicant pool will increase or decrease based on overall recruiting market conditions. These market conditions are assumed to be, to a first order approximation, largely independent of the actual incentives allocated to individual MOS by the EIRB model. Rather, we suggest that these market conditions, which will affect the number of high quality applicants, include the aggregate unemployment rate, military pay relative to civilian pay, Army production recruiters, and Army advertising.

As the overall recruiting market shifts toward a market more favorable to recruiting, the proportion of applicants who are "qualified" should increase, and the proportion of high quality contracts realized should also increase. The purpose of this note is to describe an adjustment to the applicant pool, as a function of overall recruiting market conditions, that will account for the more aggregate effects of the recruiting market.

Supply Constrained Applicants

We assume that qualified applicants (and high quality contracts) are "supply constrained". They increase or decrease as factors affecting market supply change. Qualified applicants and recruits are, in a sense, "on" the supply curve. This is the assumption, implicit or explicit, in econometric estimates for market factors (pay, the unemployment rate, recruiters, and others) affecting recruit supply.

Other applicants are assumed to be "demand constrained". More of these types of potential recruits would be willing to apply and willing to enter the Army, but recruiters constrain the number based on the "demand"—the numbers recruiters need to make their mission given the number of high quality recruits available. Recruiters can increase or decrease the number of other applicants or contracts, within a reasonable range of variation, independently of market conditions and incentives because these types of applicants and recruits are limited by demand, not supply.

Our approach to estimating the effects of market factors is based on this general proposition that qualified applicants (and recruits) are supply constrained, and other applicants and recruits are demand constrained.

Changes in Training Seat/Contract Goals

When the total positions to be filled across MOS change, with no change in recruiting market factors, how should the applicant pool be adjusted to reflect the change in requirements (or seats to be filled) in the period? Based on the underlying proposition that qualified recruits are supply constrained, there would, to a first approximation, be no change in qualified applicant or contracts, as long as other factors remain constant.

On the other hand, we assume that other applicants will increase or decrease to exactly match the change in training seats or mission for that period. Hence, let G_t be the overall number of slots to be filled in period *t* and G_{t+1} be the number of positions be filled in period *t*+1. Further, let φ_{NHQ} and φ_{HQ} be the shares of total applicants that are other (*O*) and qualified (*Q*) in the base period, respectively. Then, the number of other applicants for period t=1 is adjusted based on the change in *G* between the two periods according the following:

$$O_{t+1} = \left(1 + \left(\left(\frac{G_{t+1}}{G_t} - 1\right) * \frac{1}{\varphi_O}\right)\right) * O_t = \mu_G * O_t,$$

where μ_G is the adjustment factor, applied only to other applicants, to adjust for changes in the required number of positions to be filled, *G*.

The effect of this adjustment, which assumes market factors affecting high quality are unchanged, is intuitive. When the overall number of positions to be filled goes down in period *t*+1, other things being equal, the proportion filled by qualified applicants will go up. The reduction in applicants and contracts will be taken entirely from other applicants. Similarly, when *G* increases, with market factors remaining unchanged, the increase will be filled entirely by other applicants and the proportion filled by qualified applicants will decline.

Market Adjustment Model

We now consider the case where the market changes. In this case, the market change directly affects the number of qualified applicants. If the market becomes more conducive to recruiting (e.g., the unemployment rate increases) there will be an increase in qualified applicants, and vice versa. However, unlike the adjustment for goals, we assume that the "demand" constrained other applicants change by the same absolute amount as the qualified, but in the opposite direction. Hence, with *G* remaining the same, total applicants remain unchanged. The market change results in a shift between qualified (supply constrained) applicants and a corresponding change in other (demand constrained) applicants that exactly offsets the change in qualified applicants.

We propose the following model to adjust the pool of applicants to reflect changes in the overall recruiting market. Let the supply of qualified applicants be determined by the following equation:

$$Q_t = \alpha U_t^{\beta 1} \left(\frac{M}{C}\right)_t^{\beta 2} Rec_t^{\beta 3} Adv_t^{\beta 4},$$

where Q_t is the number of qualified applicants at period *t*, U_t is the unemployment rate in period *t*, $(M/C)_t$ is a measure of relative military to civilian pay at period *t*, Rec_t is the number of Army production recruiters at period *t*, and Adv_t is a measure of Army enlistment advertising expenditures at *t*.

Now, let *t* be the base line for qualified applicants. Then, the expected relative change in qualified applicants between *t* and *t*+1 is given by:

$$\frac{Q_{t+1}}{Q_t} = \mu_{t+1}$$

where μ_{t+1} is a scale factor such that $Q_t * \mu_{t+1} = Q_{t+1}$.

We can estimate μ_{t+1} directly by applying the equations for Q in period *t* and *t*+1, as indicated above. Alternatively, we can note that:

$$lnQ_t = ln\alpha + \beta 1 lnU_t + \beta 2 ln(\frac{M}{C})_t + \beta 3 \ln Rec_t + \beta 4 lnAdv_t.$$

Taking the total derivative, we obtain:

$$dlnQ_t = \frac{dQ_t}{Q_t} = \beta 1 \frac{dU_t}{U_y} + \beta 2 \frac{d(\frac{M}{C})_t}{(\frac{M}{C})_t} + \beta 3 \frac{dRec_t}{Rec_t} + \beta 4 \frac{dAdv_t}{Adv_t}.$$

Hence, we can approximate μ_{t+1} as:

$$1 + \beta 1 * percent\ change\ in\ Unemployment\ rate + \beta 2 * perent\ change\ in\ relative\ pay + \beta 3 * percent\ change\ in\ recruiters + \beta 4 * percent\ change\ in\ advertising$$

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Adjustment to Other Applicants

The nature of the simulation model is that, to a first approximation, the quality distribution of recruits that are assigned to jobs in the model will roughly mirror the quality distribution of applicants that begin the simulation. In practice, as the recruiting market shifts so that it becomes easier to induce qualified applicants to apply, recruiters will focus on qualified applicants. They will send a larger portion of qualified applicants to the MEPS for processing, and fewer other applicants. As a result, the overall quality distribution of contracts and, eventually, accessions will increase. Similarly, when the recruiting market becomes more difficult, the opposite will occur.

To help to ensure that the simulation model's distribution of recruits by quality will reflect the results of changes in the recruiting market as a whole, we adjust both qualified recruits and other recruits in response to overall market effects.

We use the parameter $\mu_{Q,t+1}$ to adjust the number of qualified applicants (as defined above) in the baseline cohort at *t*. Let Q_t be the number of qualified applicants in the baseline period. Then, in period *t*+1, the number of qualified applicants is:

$$Q_t * \mu_{Q,t+1}.$$

Now, if the number of qualified applicants expands (or contracts), there presumably will be a corresponding change in other applicants, UQ. We propose that change exactly offsets the change in qualified, so that the total number of applicants remains approximately constant. In particular, we have:

$$Q_{t+1} = Q_t * \mu_{Q,t+1}$$

The adjustment to other (O) applicants should offset the change in Q applicants, keeping the total applicant numbers constant in the simulation. Then, if $(\mu_{Q,t+1} - 1)$ is equal to the percentage change in Q applicants, then other applicants should change by:

$$\mu_{O,t+1} = \frac{Q_t}{O_t}\left(1 - \mu_{Q,t+1}\right).$$

In words, quite simply, the numeric change in the number of qualified applicants is offset by the change in the number of other applicants, keeping the total applicant pool for the simulation constant.

Parameters

A key component of the market adjustment segment is the set response parameters associated with changes in the unemployment rate, relative pay, recruiting effort, and advertising. Given the way we have specified the model, we need to include estimates of the effects of unemployment, pay, recruiters and advertising.

Almost all of the empirical research on estimating the parameters of a recruit supply equation has two characteristics: (a) it has focused on qualified recruits; and (b) it has focused on contracts, not applicants. The first restriction, that the literature has focused on estimating supply parameters for high quality recruits, is consistent with the proposition underlying the market adjustment factor that it is high quality recruits that are supply constrained.[6] The second restriction, that the literature applies to contracts not applicants, will not, we believe, bias our

[6] There has been an important strain of literature that has demonstrated the effect that recruiter behavior may have on traditional supply parameter estimates. The effect of a change in the unemployment rate, other things being equal, may depend on concomitant changes in recruiters' mission. If the mission were to stay the same, some of the benefits of a more willing recruiting market for qualified recruits may be taken in the form of recruiter leisure, rather than additional qualified recruits. This line of research, first articulated by Chris Jehn but pursued most rigorously by James Dertouszos, is important. However, for our purposes, the traditionally estimated average response to changes in the supply factors on high quality contracts is sufficient. We are not, in this model, as concerned about what the change could have been if, for example, recruiters' incentive were adjusted optimally.

results. In the estimates for which contracts were the dependent variable, the underlying process is the same as that implied in the model. Prospects become applicants and then recruits. In our model, the final output is really not the change in the quality mix of applicants, but the change in the quality mix of those filling jobs. Hence, if the model's results are approximately consistent with the empirical literature on the effect of market factors on high quality contracts, we believe we have adequately captured the effect of market factors on the quality distribution of those filling Army jobs.

Table 14 provides a range of estimates for relative pay and unemployment, both for the Army and for the other Services. Based on the results from the literature cited in Table 14, we recommend a default value for $\beta 1$, the Army relative pay elasticity, of 1.0 and an unemployment elasticity, $\beta 2,\ of\ 0.25$.

Table 14***. External Market Factor Elasticities***

Study	Service	Date Type and Time Period	Relative Pay	Unemployment
Asch et al. (2010)	Army	Quarterly by state, 2000-2008	1.15	0.11
	Navy	Quarterly by state, 2000-2008	0.73	0.12
Warner & Simon (2007)	Army	Quarterly by state, 1996-2003	0.70	0.42
Warner & Simon (2004)	Army	Quarterly by state, 1989-2003	0.71-0.81	0.25-0.31
	Navy	Quarterly by state, 1989-2003	0.62	0.29
	USAF	Quarterly by state, 1989-2003	0.40	0.24
	USMC	Quarterly by state, 1989-2003	0.64	0.15
Warner et al. (2003)	Army	Monthly by state, 1989-1997	0.78	0.22
	Navy	Monthly by state, 1989-1997	0.95	0.26
	USAF	Monthly by state, 1989-1997	0.47	0.19
	USMC	Monthly by state, 1989-1997	0.23	0.28
Hogan et al. (1996)	Navy		0.55	0.18
WSP Let Review Mean	various	Various, pre-drawdown	0.75	0.62

Note: From Appendix B of Warner et al. (2001)

Table 15 reports recruiter elasticities, $\beta 3$, and advertising elasticities, $\beta 4$, for the Army and for the other Services. Based on the results cited in the literature from Table 15, we recommend a default recruiter elasticity of 0.55 and a default advertising elasticity of 0.05.

Table 15. ***Recruiting Resource Elasticities***

Study	Service	Date Type and Time Period	Recruiters	Advertising
Asch et al. (2010)	Army	Quarterly by state, 2000-2008	0.57-0.63	
	Navy	Quarterly by state, 2000-2008	0.22-0.41	
Warner & Simon (2007)	Army	Quarterly by state, 1996-2003	0.47(+), 0.62(-)	
Warner & Simon (2004)	Army	Quarterly by state, 1989-2003	0.53	0.05
	Navy	Quarterly by state, 1989-2003	0.53	0.05
	USAF	Quarterly by state, 1989-2003	0.57	0.01
	USMC	Quarterly by state, 1989-2003	0.59	0.03
Hogan et al. (1996)	Navy		0.29	0.021 (Radio), 0.03 (TV)
WSP Let Review Mean	various	Various, pre-drawdown	0.76	0.10

Note: From Appendix B of Warner et al. (2001)

Example

Assume that, between period *t* and *t*+1, the unemployment rate increased by 10% and recruiters increased by 5%. All other factors remained the same. Applying the equation:

$$dlnQ_t = \frac{dQ_t}{Q_t} = \beta 1 \frac{dU_t}{U_y} + \beta 2 \frac{d(\frac{M}{C})_t}{(\frac{M}{C})_t} + \beta 3 \frac{dRec_t}{Rec_t} + \beta 4 \frac{dAdv_t}{Adv_t},$$

we find that the value of $\mu_{HQ,t+1}$ is 1.052, indicating a 5.2% increase in the number of qualified applicants.

Policy Cost Estimation Model

It is useful, in evaluating a given incentive plan in terms of its effect on the distribution of recruits across MOS and terms of service, to also have a rough estimate of the cost of the program. The iterative process of moving as close as possible toward desired recruit quality distribution goals while remaining within a budget for incentives would necessitate such an estimate. We now describe a model for estimating the costs that are associated with the EB and the LRP. Because the ACF is not currently offered in conjunction with the Post-911 G.I. Bill, we will not formally consider it in the cost analysis.

For both the EB and the LRP, the model assumed that eligibility requires

- qualifying and choosing an MOS offering the incentive;
- scoring in the upper half of the AFQT distribution; and
- having a high school diploma or being a high school senior.

The EB is offered by MOS and by length of obligation. Upon completion of initial skill training (AIT), the recruit is eligible for a payment of up to $10,000. The remainder of any EB is prorated annually over the remaining term of the enlistment. To be eligible, the candidate must enter an MOS offering an EB and the candidate must achieve a score of 50 or greater on the Armed Forces Qualification Test (AFQT).

The LRP offers repayment of student loans up to $65,000 for an enlistment in an MOS offering LRP. The enlistee must score 50 or greater on the AFQT to be eligible for loan repayment. Repayment is made in the amount of one-third of the amount of the loan annually (or one-third of the maximum), and begins only after the enlistee successfully completes one year of service. If the enlistee is eligible and takes advantage of the LRP, the enlistee is not eligible for the Montgomery GI Bill. However, should the enlistee reenlist, they may become eligible for the new (Post 911) GI Bill under the reenlistment provisions of that incentive.

The LRP is typically offered in conjunction with an enlistment bonus. If so, the eligible candidate may be offered a choice between a higher enlistment bonus award, and a reduced enlistment bonus award but coupled with loan repayment. If the reduced bonus award includes the case of a bonus of zero, an MOS may offer potentially three choices to eligible applications: (a) a bonus only; (b) loan repayment only; and (c) a bonus plus loan repayment.

The cost estimates of these programs provided in this section will be approximate for at least two reasons. First, for some of the programs (LRP, for example) the amount of the actual benefit depends on the particular circumstances of the recipient. In the case of LRP, it will depend on the amount of debt that the recruit has incurred. Second, we estimate the expected costs of the incentive, but do not attempt to allocate those to costs to the particular fiscal year in which the outlay occurs. For example, the first installment on the enlistment bonus is paid upon successful completion of initial skill training. Subsequent installments are then paid annually during the first term enlistment period.

Enlistment Bonus

Let the number of recruits (contracts) for MOS *j*, enlistment length *l*, who score at least 50 on the AFQT, are of education level *e*, and who accept an enlistment bonus as an incentive be denoted as $MOS_{j,l,e,B}$. Recruits in this MOS are offered an enlistment bonus of $B_{j,l}$. Moreover, the survival rate from the delayed entry program through boot camp and initial skill training, required in order to receive the bonus, is $S_{j,l,e}$.[7] Then, the cost of the bonus is given by:

$$Cost\_Bonus_{j,l,e,} = MOS_{j,l,e,B} * B_{j,l} * S_{j,l,e}$$

The total expected cost of bonuses across all MOS and lengths of obligated service is given by:

$$Total\_Cost\_Bonus = \sum_{l} \sum_{j} \sum_{e} MOS_{j,l,e,B} * B_{j,l} * S_{j,l,e}$$

Student Loan Repayment Program

[7] Note that this formulation allows the survival rate to vary with the applicant's education, e. However, the education dimension may be suppressed if there is not sufficient information to support variation by education.

In the general case, and adapting the notation of the previous section, the expected cost of LRP for MOS j and enlistment contract length l is:

$$Cost\_LRP_{j,l,e} = MOS_{j,l,e,LRP} * LRP_{j,l} * S'_{j,l,e},$$

where $S'_{j,l,e}$ is the survival rate form entry into the Delayed Entry Program through one year of service for those in MOS *j* and contract length *l*, and education level *e*, who accept the LRP incentive.[8] The total expected cost is given by:

$$Total\_Cost\_LRP = \sum_{l} \sum_{j} \sum_{e} MOS_{j,l,e,LRP} * LRP_{j,l} * S'_{j,l,e}$$

Enlistment Bonus and Loan Repayment

Finally, we consider the third case—applicants who are offered and accept both an enlistment bonus and loan repayment in a particular MOS. We anticipate that, in the general case, these applicants may have had a choice, in the same MOS, of a higher enlistment bonus but without loan repayment.

Let the number in MOS *j*, and length of contract *l* who accept an offered loan repayment and an enlistment bonus be denoted $MOS_{j,l,B+SLRP}$. Then, the expected cost of the loan repayment portion of the incentive package is:

$$Cost\_LRP_{j,l,e} = MOS_{j,l,e,B+,LRP} * LRP_{j,l} * S'_{j,l,e}$$

Total costs are then:

$$Total\_Cost\_LRP = \sum_{l} \sum_{j} \sum_{e} MOS_{j,l,e,B+,LRP} * LRP_{j,l} * S'_{j,l,e}$$

The cost of bonus portion of the incentive package is:

$$Cost\_Bonus_{j,l,e} = MOS_{j,l,e,B+LRP} * B_{j,l,LRP} * S_{j,l,e}$$

In this equation, the notation is modified to indicate that the bonus accepted by recruits in MOS *j*, term of service *l*, to indicate that, because of the bonus and LRP "package" the bonus may be different than (most likely lower than) the bonus if the applicant were to choose only the enlistment bonus. Total costs are:

$$Total\_Cost\_Bonus = \sum_{l} \sum_{j} \sum_{e} MOS_{j,l,e,B+LRP} * B_{j,l,LRP} * S_{j,l,e}$$

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[8] Note that, for student loan repayment, the education level will probably be restricted to "some college" or "college graduate."

Data

The nominal size of the enlistment bonus will be determined in the simulation. However, the LRP payment will depend on the size of the applicant's student debt that is eligible for repayment. The average undergraduate student debt for the class of 2011 was about $26,000.[9] In addition, the Army budget justification book for 2013[10] indicates expected costs of about $56.5 million for FY 2013, with about 9500 participants. This is an average annual payment of about $6,000 per participant. Assuming that this average represents one-third of total payments, the expected cost per applicant would be about $18,000. In the absence of better information, we will use this as an estimate of the cost of the program, to those recruits who are offered LRP.

Basic training attrition rates are about 14%.[11] The relevant measure for enlistment bonuses is attrition through advanced individual skill training. We will use an estimate, for bonus recipients of 15% from accession to completion of AIT. Because high school seniors remain longer in the delayed entry program (DEP) than high school graduates, we will assume that the attrition rate from DEP is 15% for Seniors and 10% for high school graduates and those with education beyond high school. Combined with survival through AIT, this implies a survival rate of 70% for high school seniors and 75% of high school graduates.[12] For loan repayment, the recruit must complete a full year of service. We will use 20% as the first year attrition rate, or an 80% survival rate, in the absence of better information. Coupled with DEP attrition, this is a survival rate of 70%.[13]

Number Who Take Offered Incentives

For each MOS, the cost model will multiply the number eligible for the incentive by the expected cost of the incentive, conditional on eligibility. Hence, for each MOS offering incentives, one needs the number, within an MOS, who will take each incentive offered for that MOS.

We assume that high school seniors and high school graduates will not choose, nor incur costs, for the student loan repayment program. Without having at least some college, the recruit applicants will have no student loans to repay.

For recruits who have some college or a college degree, we can consider several cases:

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[9] See http://www.asa.org/policy/resources/stats/.

[10] Department of the Army FY 2013 Budget Estimates, Military Personnel, Army. February 2012.

[11] This estimate is for FY 2006 and is from "United States Military basic Training Attrition Rates." Department of Defense.

[12] Asch et al (2010) find that bonus recipients have slightly lower first term attrition rates. See Beth Asch, Paul Heaton, James Hosek, Francisco Martorell, Curtis Simon and John Warner, "Cash Incentives and Military Enlistment, Attrition and Reenlistment," Rand National Defense Research Institute, 2010.

[13] Note that high school seniors will not be attracted by the loan repayment program, not having incurred any college debt.

1. If the MOS offers only an enlistment bonus or only student loan repayment, those with some college or a college degree in that MOS will be allocated to that incentive offered.
2. If the MOS offers applicants either an enlistment bonus, loan repayment, or loan repayment with a reduced enlistment bonus, those with some college or who are college graduates will split in the proportions, by years of obligated service (YO):
    a. 3 YO: 49% EB 33% reduced EB with LRP 16% loan repayment only
    b. 4 YO: 75% EB 11% reduced EB with LRP 12% loan repayment only
    c. 5 YO: 62% EB 13% reduced EB with LRP 23% loan repayment only
    d. 6 YO: 85% EB 13% reduced EB with LRP 1% loan repayment only
3. If the choice is between an enlistment bonus or loan repayment, we will use the results in (2) above but eliminate the reduced EB with LRP option:
    a. 3 YO: 75% EB 25% loan repayment only
    b. 4 YO: 86% EB 14% loan repayment only
    c. 5 YO: 73% EB 27% loan repayment only
    d. 6 YO: 99% EB 1% loan repayment only

Summary

Table 16 provides an overall summary of the cost-estimation model and default parameters.

Table 16. ***Summary of Cost Estimation Equations and Default Parameters***

Incentive Type	Equation	Default Parameters
Enlistment Bonus (only)	$Cost\_Bonus_{j,l} = MOS_{j,l,B} * B_{j,l} * S_{j,l}$	Survival rate = 0.75 (high school grad or college) = 0.70 (high school seniors)
Loan repayment (only)	$Cost\_SLRP_{j,l} = MOS_{j,l,B+,SLRP} * SLRP_{j,l} * S'_{j,l}$	Amount = $18,000 Survival rate = 0.7
Bonus (w/loan repayment)	$Cost\_Bonus_{j,l} = MOS_{j,l,B+SLRP} * B_{j,l,SLRP} * S_{j,l}$	Survival rate = 0.85
Loan repayment (w/bonus)	$Cost\_Bonus_{j,l} = MOS_{j,l,B+SLRP} * B_{j,l,SLRP} * S_{j,l}$	Amount = $18,000 Survival rate = 0.8

What-If-Simulation Capability Design

The heart of the DST is a simulation that estimates applicant choice probabilities based on the available occupational options, incentives, and applicant characteristics. The simulation implements the JCM on a sample of somewhat over 8,000 simulated applicants, weighted to represent the applicant distribution. The initial weights for the sample are based on their

prevalence in the sample for which the JCM was estimated, that is, the first two quarters of FY 2010. These weights are adjusted to reflect market effects, as described previously.

Defining the Incentives

The EIRB's EB/ACF incentive policy is represented by two tables in the quarterly incentive specification memorandum published by the office of the Army G-1. The first table specifies the dollar amounts for each of five incentive levels across TOS. For example, Table 17 shows the dollar values by level and type of incentive in the first quarter of FY 2010. There are five incentive levels defined in the table. For each incentive level, the table specifies three types of incentives: (a) EB only, (b) ACF, with or without a reduced EB, and (c) LRP with a reduced EB. Since ACF is currently not being offered, the simulation does not consider this incentive in its cost estimate and the JCM does not allocate any applicants to the ACF. LRP is also not used in the JCM, but an estimate of the overall proportion that choose this option is used to estimate the total cost of the incentive, as described in the previous discussion about the cost model.

Table 17. ***Definition of Incentive Levels***

Incentive Level	Incentive Type	Term of Service							
		3		4		5		6	
		Bonus	ACF	Bonus	ACF	Bonus	ACF	Bonus	ACF
1	EB Only	7,000		10,000		15,000		20,000	
	EB + ACF	4,000	350	5,000	650	8,000	850	10,000	950
	EB + LRP	4,000		5,000		8,000		10,000	
2	EB Only	4,000		7,000		10,000		15,000	
	EB + ACF	2,000	350	4,000	650	5,000	850	8,000	950
	EB + LRP	2,000		4,000		5,000		8,000	
3	EB Only	2,000		3,000		6,000		8,000	
	ACF Only		350		650		850		950
	EB + LRP	0		0		0		0	
4	EB Only	0		950		3,000		6,000	
	ACF Only		350		650		850		950
	EB + LRP	0		0		0		0	
5	EB Only	0		0		0		0	
	ACF Only		350		650		850		950
	EB + LRP	0		0		0		0	

The second table specifies the incentive level and minimum TOS to be eligible for the incentive by MOS. For example, Table 18 shows the levels and minimum TOS for several MOS in Q1 of FY 2010. The DST allows the user to specify these inputs to define an incentive policy scenario.

Table 18. ***Incentive Level and Minimum TOS for Selected MOS***

MOS	Title	Incentive Level	Min. TOS
11X	Infantry Enlistment Option	3	3
12B	Combat Engineer	5	3
12C	Bridge Crewmember	5	3
12D	Diver	5	4
12K	Plumber	No Incentive	3
12M	Firefighter	No Incentive	3
12N	Horizontal Construction Engineer	No Incentive	3
12R	Interior Elec trician	No Incentive	3
12T	Technical Engineer	No Incentive	3
12V	Concrete and Asphalt Equipment Operator	No Incentive	3
12W	Carpentry and Masonry Specialist	No Incentive	3
12Y	Geospatial Engineer	4	4

Contract Requirements

Each year, the Army develops accession requirements by MOS that reflect the need for newly trained Soldiers in each entry MOS. Training opportunities are scheduled to provide sufficient capacity to meet the accession requirements. Both the accession requirements and the fill of training opportunities are tracked on a continual basis in the Target report produced by HRC.

Applicants sign enlistment contracts that assign them future training dates for the MOS that they selected. The REQUEST system manages the availability of MOS training opportunities, closing them when they are filled and opening opportunities at later dates when there is a need to fill them. Consequently, the contract requirements for a specific time period are a function of both the accession requirements and the extent to which these requirements have already been filled by previous contracts. The REQUEST system manages this process, producing a set of DEP tables that specify which MOS are open for enlistment during specific months. These tables can change daily, or even within a day, as MOS training opportunities are filled.

The complexity of the relationship between accession requirements and contract requirements forced us to make some simplifying assumptions and to design the system to allow the user to make changes when these assumptions were wrong. We based contract requirements for a given period of time (a fiscal quarter or year) on the number of actual contracts that were signed in the comparable period in a previous year. To do this, we obtained Target reports for the beginning of each quarter of FY 2010, and for the beginning of FY 2011. Subtracting the fill for adjacent quarters produced an estimate of the number of contracts that were signed during that quarter. We then used that estimate as the baseline contracts requirement for a comparable quarter in fiscal year being analyzed. The EIRB-DST allows the user to edit these requirements for each MOS.

The user also specifies a threshold, a value that indicates the extent to which the contract requirements must be filled. The threshold is initially set to 1.0, which indicates that the simulation will close a particular MOS when all requirements have been met. Setting the

threshold to a value lower than 1.0 will instruct the simulation to close the MOS before all requirements are met. For example, if the threshold for 11X, Infantry Enlistment Option, is set to 0.9, then the simulation will close the MOS when 3,102 simulated contracts were signed (90% of the requirement of 3,447). Similarly, if the threshold were set to 1.25, the simulation would hold the MOS open until the number of contracts exceeded the requirement by 25% (or 4,309 contracts). Table 19 shows a portion of the table describing MOS contract requirements and the requirement threshold.

Table 19. ***Contract Requirements and Analysis Threshold for Selected MOS***

MOS	Title	Contracts Baseline	Contracts Projected		Threshold
11X	Infantry Enlistment Option	3,447	3,447		1
12B	Combat Engineer	465	465		1
12C	Bridge Crewmember	87	87		1
12D	Diver	29	29		1
12K	Plumber	44	44		1
12M	Firefighter	1	1		1
12N	Horizontal Construction Engineer	219	219		1
12R	Interior Elec trician	10	10		1
12T	Technical Engineer	36	36		1
12V	Concrete and Asphalt Equipment Operator	14	14		1
12W	Carpentry and Masonry Specialist	24	24		1
12Y	Geospatial Engineer	64	64		1

Simulation Operation

In the previous version of the EIRB-DST, the JCM simulation capability used components from the Biogeme software. However, this approach made the simulation slow, taking over 15 minutes to complete. Consequently, we developed a program to conduct the simulation that is implemented as an add-in to Excel. The simulation consists of the following steps:

(1) *Construct the simulated applicant transaction data based on the weighted FY 2010 estimation data.* The job lists in the simulated data were constructed based on MOS eligibility requirements using applicant gender and aptitude scores, with all incentives zeroed out. These data serve as the starting point for each of the four policy simulation analyses.

(2) *Generate the simulated transaction data under a given incentive policy scenario.* The full EB is computed for each enlistment alternative based on applicant's eligibility and MOS incentive level under a given incentive policy decision.

(3) *Apply the JCM to obtain expected MOS/TOS accessions under a given policy scenario using batches of 20 applicants.* Using the estimated JCM, choice probabilities are computed for each applicant in a given batch based on the incentives specified in step (2). Expected accessions are obtained by computing the weighted sum of the choice probabilities by MOS and TOS across simulated applicants.

(4) *Update remaining MOS requirements at the end of each simulation batch.* Cumulative total fill for each MOS is computed using the expected accessions in step (3). An MOS with total fill that is equal to or exceeds the corresponding MOS requirement at the start of the simulation is dropped from the job list of applicants in subsequent batches.

(5) *Use the expected MOS/TOS accessions to estimate the total cost of the incentives by MOS and TOS.* Output from the JCM includes the number of applicants who are expected to take the EB, and/or LRP incentives by MOS and TOS. Using these estimates, the DST is able to compute the expected total cost for the EB and LRP incentives for the full applicant sample and by MOS and TOS.

(6) *Compare estimated accessions obtained from an alternative policy against a baseline policy.* The DST includes a functionality for reporting the channeling effects of a given incentive policy. This is reported in terms of the differences in estimated accessions and associated cost by MOS and TOS between a given incentive policy and a baseline policy.

ARMY ENLISTMENT INCENTIVE REVIEW BOARD DECISION SUPPORT TOOL

Introduction

One of the objectives of this project was to incorporate the job choice model into a decision support tool for the EIRB. A proof-of-concept model was developed in previous research, but this software had several limitations. Chief among these were slow execution and restriction to clusters of jobs. The Enlistment Incentive Review Board Decision Support Tool (EIRB-DST) overcomes these shortcomings and offers other enhancements. The EIRB-DST may be used by Army analysts to explore alternative incentive plans in preparation for EIRB deliberations. It will simulate job choice behavior and provide estimates of contracts by job and term of service as well as cost estimates.

A detailed user manual is included in Appendix A.

Features

The EIRB-DST is based in Microsoft Excel with a customized user interface using Visual Basic for Applications (VBA) macros. Scenario output data are stored in an associated Microsoft Access database while scenario input data are stored in the MS Excel workbook. There is also another MS Excel workbook that takes the raw applicant data and creates variables that are used in the simulation based on the applicants' qualities and test scores. The model also integrates an enlistment supply module as well as a cost module with the JCM Simulation in order to create the job choice outcomes. The top-level design of the EIRB-DST is shown in Figure 1.

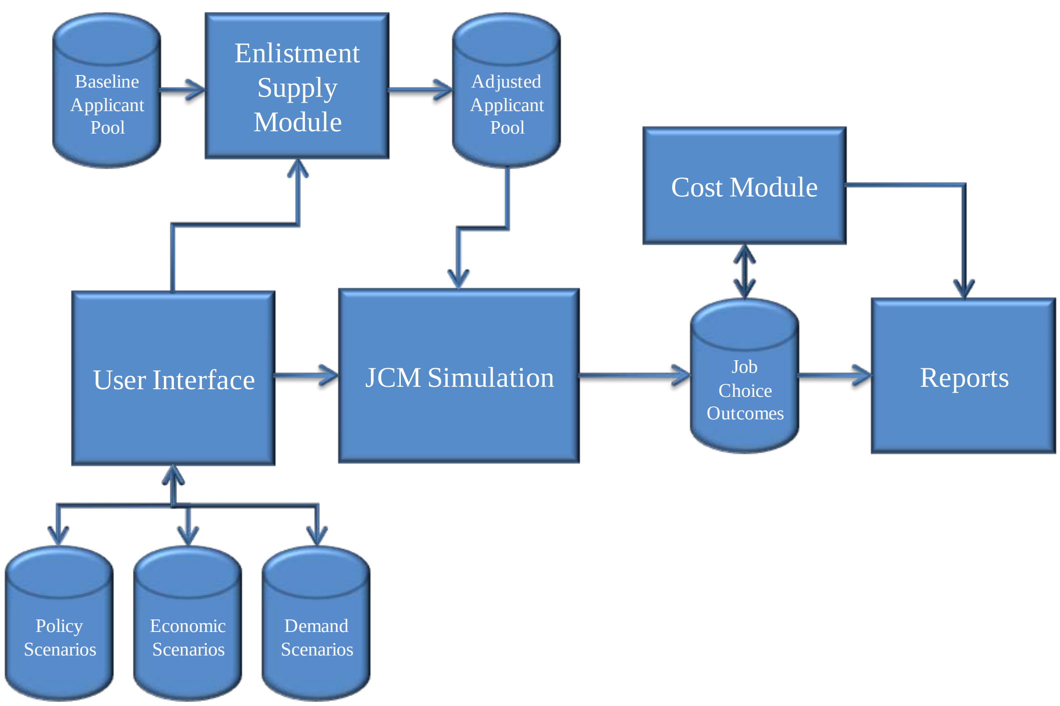

Figure 1. Model features.

Users enter policy scenarios, economic scenarios, and demand scenarios into the user interface. Some of those inputs are then used in the enlistment supply module to adjust the baseline applicant pool based on goal changes and market changes, which creates the adjusted applicant pool.

The user inputs and the adjusted applicant pool are used in the JCM Simulation to predict the probability that applicants will choose each job/TOS for which they are eligible. At the same time, the cost module formulates the enlistment bonus (EB) cost, the Army College Fund (ACF) cost, and loan repayment program (LRP) cost for estimates for each predicted outcome. The ACF option is currently disabled as the Army is no longer offering this incentive option. Cost estimates using the algorithms described previously are based on the incentive eligibility of the individual; the probability of choosing a job/TOS; the likelihood of attriting from DEP or the training pipeline, and the historical distribution of incentive takers across incentive choices.

The job choice probabilities and their associated costs are written to the MS Access database as the output. The EIRB-DST contains several reports that aggregate and display the detailed output.

Components

The EIRB-DST model utilizes worksheets to accept user input and uses a somewhat linear-flow to take the user from the home sheet to the summary output, as shown in Figure 2.

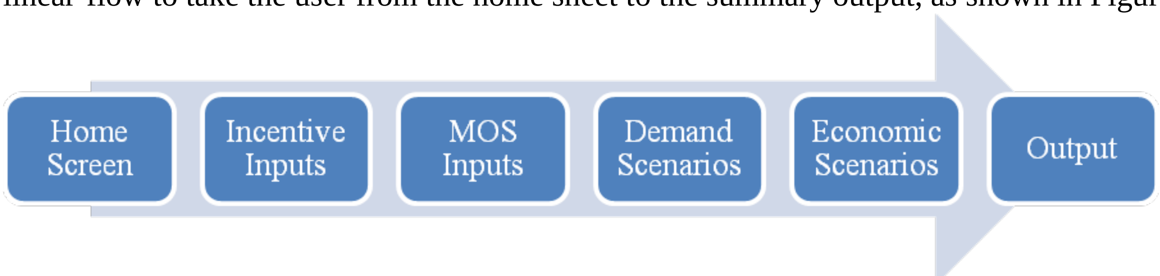

Figure 2. Model Flow

Scenario Management

On the *Home* sheet, the user is able to create a new scenario, open a saved scenario, delete a saved scenario, import a scenario, and export a scenario. Scenarios can be exported in order to share the saved user inputs with others. The .ini files that are created by exporting can then be sent to other users who can then use the import feature to create the same scenario in their computers model.

Incentive Inputs

The *Incentive Inputs* sheet is the first sheet where users are prompted for input. This page allows the user to change the incentive amounts for the different incentive levels. The user may set Enlistment Bonus levels for both the Enlistment Bonus only and Enlistment Bonus plus Loan Repayment Program options for each incentive level. There are five incentive levels in the model, although individual jobs may also be assigned a sixth level (no incentives).

MOS Inputs

The next sheet in the model flow is the *MOS Inputs* sheet. The MOS Inputs page allows the user to select an incentive level and minimum term of service for each MOS job category. The values for each incentive level and minimum term of service were constructed on the *Incentive Inputs* page.

Demand Scenarios

After selecting incentive levels and minimum terms of service for each job, the user is guided to the Demand Scenarios page, where he or she enters the projected contract requirements and thresholds for each MOS job specialty. This sheet also houses baseline contract requirements.

Economic Scenarios/Enlistment Supply

The last sheet before the summary reports is the *Economic Scenarios* sheet. This sheet prompts the user to input the projected unemployment rate, relative military pay, number of production recruiters, and advertising dollars for the projected year. This sheet also houses the baseline values for these inputs.

Adjustments are made to the enlistment supply based on the percent change of these market factors entered in the *Economic Scenarios* sheet. There are also adjustments made to the enlistment supply based on the percent change in baseline contracts and projected contracts entered on the *Demand Scenarios* sheet.

Output/Reports

In the main summary sheet, the model displays the total contracts, total incentive takers, total enlisted bonus (EB) cost, total Army College Fund (ACF) cost, and total loan repayment program (LRP) cost by job. The user can also change the scenario to be reviewed after arriving at this summary sheet.

The main summary sheet also contains buttons that will return the user to the model inputs, redo the simulation for the selected scenario, save the scenario, and take the user back to the home screen.

There are 3 other summary sheets: the summary by TOS sheet, the compare scenarios sheet, and the met contract requirements sheet. The *Summary by TOS* sheet is similar to the main summary sheet, only with the values broken down by TOS as well as job. The *Compare Scenarios* sheet allows you to compare the numbers on the main summary sheet between two different scenarios. Finally, the *Met Contract Requirement* worksheet allows the user to see when a job was “filled” based on the projected contracts the user entered into the model.

DISCUSSION AND RECOMMENDATIONS

In the previous research, Diaz et al. (2012) developed a JCM that predicted applicants' choices among the MOS training opportunities offered to them by the Army's REQUEST system. They then incorporated the JCM into a proof-of-concept DST that illustrated how such a model could be used to help the EIRB make effective and efficient decisions about the incentives they offer for enlistment. Although the DST illustrated the utility of the approach, they uncovered several limitations that needed to be addressed to produce a useful and usable tool to support the EIRB's decisions. The goal of the current effort was to address these limitations by enhancing the JCM to be more widely applicable, developing additional modules to represent market effects on the distribution of applicants and to estimate the cost of implementing an incentive policy, and producing a more capable, efficient, and usable prototype DST.

The following discussion summarized our progress regarding the JCM, the enlisted supply and incentive cost models, the choice simulation incorporated in the DST, and the capability and efficiency of the DST software. We conclude this report with a discussion of the limitations that remain and opportunities for expansion of the capabilities of the models.

Summary of Accomplishments

In our revised JCM, the model was estimated based on all of the available MOS opportunities for which an applicant was qualified, instead of only those that appeared on the applicant's REQUEST list. The REQUEST list already includes an element of applicant preferences, since it was the result of a query generated by the applicant. Consequently, the original JCM only captured the parts of the applicant's preference that weren't included in the query. The revised JCM provides a better account for applicant choice and is more readily generalized to different time periods when different MOS opportunities are likely to be available. Specifically, the revised JCM had a pseudo R-squared of 0.32, which is substantial considering the dimension of the choice space, higher than the pseudo R-squared for the original model, which was 0.28. In addition, the JCM was validated using a hold-out sample in the same time period, as well as an out-of-period sample. The fit of the revised model in the hold-out sample was quite good, and better than the comparable fit for the original model. The fit in the out-of-period was not as good, but seemed sufficient to support the intended use of the JCM.

The revised JCM allows incentives to be set at the MOS level. This was accomplished using a two-step estimation procedure in which model parameters representing the effects of incentives and applicant characteristics were assessed using groups of MOS, and alternative-specific parameters for individual MOS were estimated with the incentive and applicant characteristics fixed. The price paid for the increased specificity and greater range of MOS considered by the model is that the choice space was restricted to consider MOS and TOS choices only, so that it did not include the choice between available combinations of EB, ACF, and LRP. Since ACF is currently not being offered, the inability to consider that incentive has no impact on the usability of the model. For the LRP, we used the overall distribution of applicants' choices of different types of incentives to estimate the cost of an incentive policy.

To apply the JCM in times other than the time for which it was estimated, it is necessary to consider changes in the applicant quality distribution due to the aggregate unemployment rate, military pay relative to civilian pay, Army production recruiters, and Army advertising. In favorable recruiting conditions (e.g., high unemployment and high relative military pay), there will be a higher proportion of high quality applicants than in a less favorable environment. Based on the econometric literature, we developed a model to estimate changes in the applicant quality distribution as a function of changes in the four variables characterizing recruiting conditions.

Obtaining a good estimate of the costs of an incentive policy is required to select the most efficient policy. The proof-of-concept DST had a notional model cost model only, so it was necessary to develop a more realistic and complete estimate of incentive policy costs. The model developed in the current effort allows the DST to estimate with reasonable accuracy the costs required to provide the EB and LRP incentives to those who select them. It considers the number of applicants who select an incentive, the level of the incentive selected, and the likelihood that the applicant will remain in the Army long enough to qualify for payment. Since the JCM did not predict the likelihood that an applicant would select the LRP, the costs for that program were estimated based on the overall percentage of qualified applicants with some college who selected that option as a function of TOS.

The proof-of-concept DST was unrealistic in allocating applicants to MOS in that it allowed popular MOS to exceed their contract goal. The DEP tables used by the REQUEST system will close MOS training opportunities when they are full so that contracts will never exceed their goal by more than a few individuals. The prototype DST better reflects this policy. Simulated applicants are allocated to MOS until the contract goals are met (to an acceptable tolerance). It allows the user to examine how quickly an MOS fills to determine whether the incentive should be raised or lowered.

Finally, we made several changes to the DST to make it easier and more efficient to use. We substantially improved the ability of the user to manage scenarios, allowing them to create, delete, import or export scenarios. The enhancements of the simulation improved the run time from over 15 minutes to less than 4 minutes. We reorganized input screens and program flow, and provided additional output reports. All of these changes have made the DST a viable tool to help the EIRB establish and evaluate incentive policies.

Needs for Enhancements

Our review of the DST has suggested several needs for enhancing the model, either to overcome limitations of the prototype or to facilitate additional analyses. These needs are enumerated in the following list.

1. *Develop and apply procedures for updating the JCM.* We anticipate that the JCM will need to be periodically estimated to calibrate it against current applicant preferences, to account for new incentives, and to reflect changes in the definition and structure of MOS. This method should rely on applicant and reservation data maintained by sources in the Army in place of REQUEST transaction data used in earlier JCM

estimation. The procedure would require a method to estimate the available MOS for which the applicant is qualified.

2. *Develop better estimates for recruit contract requirements*. Currently, contract requirements are estimated directly from previous years and adjusted manually by the user of the DST. An improved method for estimating requirements that automatically takes current contracts into consideration based on source data such as Target Reports would provide more accurate estimates and would require less user adjustment.

3. *Incorporate Quality Goals into the DST*. Recruiting conditions affect the quality distribution of applicants rather than the number of applicants. Consequently, it is important to consider the quality distribution of those who sign contracts when evaluating incentive policies. This need can be addressed in two ways. First, reports of whether quality goals are being met could be added, based on current simulation methods. Second, the simulation can be altered to try to meet MOS quality goals to the extent possible.

4. *Expand the enlistment supply model to incorporate a broader resource optimization*. This would allow the user to determine an optimal mix of recruiters, advertising, and other resources to obtain the required high quality applicants at the least cost. It might have the added advantage of providing a way to solve for the incentive budget given a set of contract requirements.

5. *Improve the cost estimation model*. The improvements would account for anniversary payments across fiscal years.

6. *Develop procedures to optimize incentive policy*. We believe that it would be beneficial to add capabilities to the DST to support user-guided optimization as a function of total cost of incentives and/or accession goals. The optimization capability will be user-guided, relying on user experience and judgment supported by DST analysis, reports, and user interface, instead of employing mathematical optimization in a black box.

7. *Revised and enhance software using MS Excel/web platform*. The DST will need to be revised and enhanced to incorporate the additional capabilities described above. We believe that the current system developed in Excel is near the limit of what can be implemented reliably using this method. Consequently, we anticipate that further developments will need to implement the model on some other platform.

Finally, it will be necessary to transition the DST to the Army, and to ensure that potential users understand and have a degree of trust in the system. The transition will require user training that explains the fundamental nature of the JCM, as well has how it is simulated in the DST. To facilitate the development of trust, we suggest that the DST be used in parallel with existing procedures for a few quarters before it is fully integrated into the decision process. In this way the users will be able to review the recommendations of the model to ensure that they make sense to the user, based on their own experience in establishing enlistment incentives for specific MOS.

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APPENDIX A

DECISION SUPPORT TOOL
USER DOCUMENTATION

Enlistment Incentive Review Board Decision Support Tool (EIRB-DST)

User Manual

HumRRO, SAG Corporation,
The Lewin Group, Inc.

Samuel Rinde, Patrick Mackin, Ted Diaz, Paul Sticha, Paul Hogan

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EIRB-DST User Manual

User Interface

Model Set-Up

The EIRB-DST model uses macros and ActiveX controls to enhance model flow and establish advanced functionality. As such, macros and ActiveX controls must be enabled prior to activating the model. Upon opening the model, a security warning will appear in either a pop-up window or along the top of the workbook. Follow the prompts to enable macros and ActiveX controls. Visual representations of these notifications are shown in Figure 1 and Figure 2.

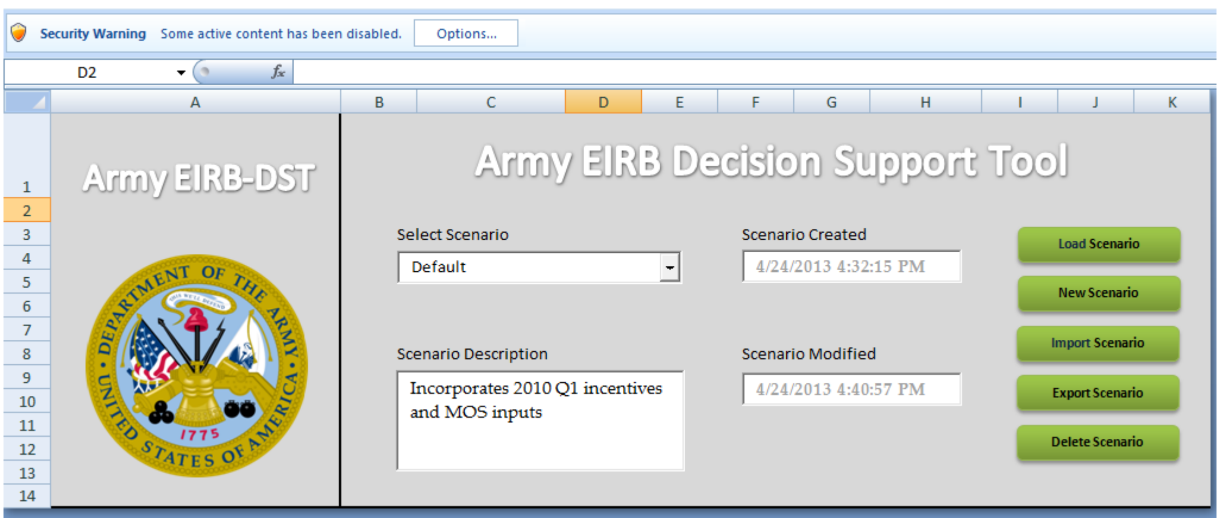

Figure 1: Security Warning

Figure 2: Click "Enable this content"

Additionally, you must install the JCMSim add-in that is provided with the model. The steps necessary to install the add-in are:

1. Copy the two associated files (JcmSimLib.dll and JcmSimLib.tlb) to your local hard drive.
2. Register the add-in.[14]
3. Add a reference to the add-in in the Excel model.

For step 3, open the EIRB-DST model and enable macros as shown above. Next, choose the Developer menu in Excel and click on Visual Basic on the toolbar (or type Alt+F11) to display the Visual Basic Editor (see **Figure 3**).

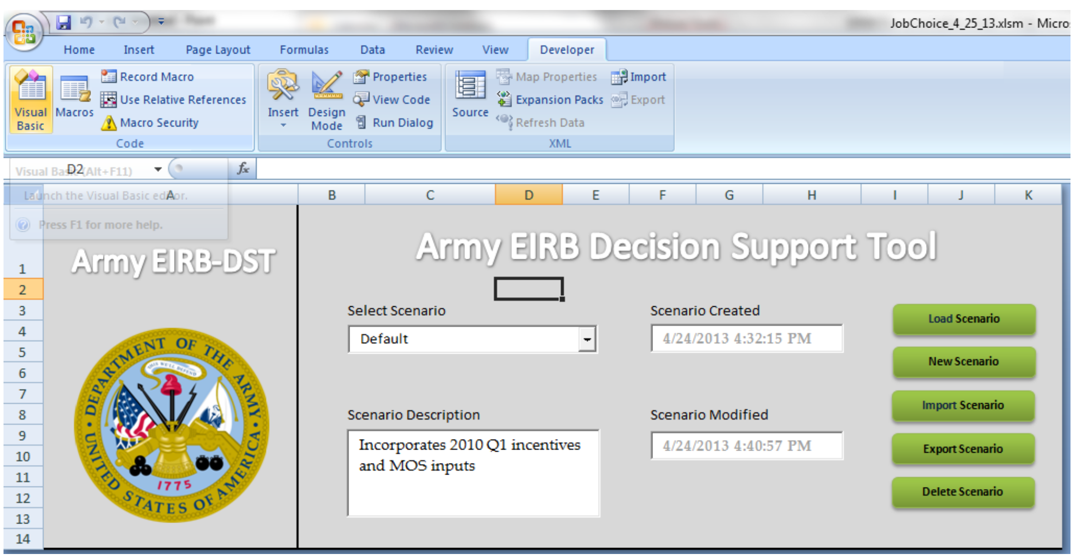

Figure 3. Opening the Visual Basic Editor

In the Visual Basic Editor, click on the Tools menu and choose References. You will see the dialog box shown in **Figure 4**. You should see a reference to JcmSimLib, but it may be noted as "(missing)". If that is

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[14] This process will vary by operating system and system configuration.

the case, single click on the JcmSimLib reference, then click the Browse button. Find the JcmSimLib.tlb file on your hard drive and click Open. The JcmSimLib reference should now be checked and no longer noted as “missing.”

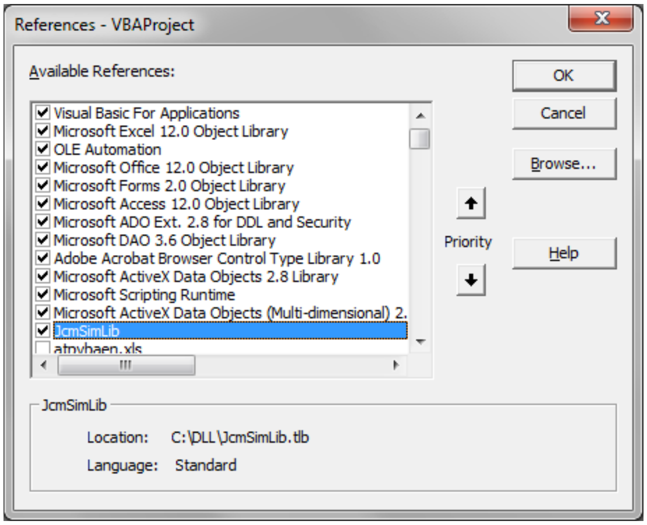


Figure 4. Setting the JcmSimLib reference in VBA

Model Flow and Input Page Descriptions

The EIRB-DST is based in MS Excel and uses worksheets to accept user input. Visual Basic for Applications (VBA) coding is used to enhance the model capabilities and reduce user input errors. The model has a somewhat linear flow – i.e., you may move forward and backward through a predefined path (see Figure 5) or jump to pages out of sequence.

Figure 5: Model Flow Diagram

The **Home Screen** (see Figure 6) allows you to:

- **Create a new scenario;**
- **Open a saved scenario;**
- **Delete a saved scenario;**
- **Import a scenario** from other users; or
- **Export a scenario** to a shared file.

To create a new scenario, click the *New Scenario* button. A form will then appear asking for a scenario name and a scenario description. Enter the information and click *Create New.* The new scenario will now

be available to open in the scenario list box. Please note that scenario names may only contain alpha-numeric characters.

To open an existing scenario, select the scenario name from the scenario list box and click *Load Scenario*. Clicking this button will lead you through the navigation flow described in **Figure 5**. You may also edit information in the scenario notes by entering information in the *Scenario Notes* textbox. Changes to scenario notes are saved upon loading the scenario.

To delete a scenario, select the scenario from the scenario combo box. Then, click the *Delete Scenario* button. Deleting a scenario will delete both the settings and any saved output.

To export a scenario file, click the *Export Scenario* button. A window will pop up prompting you to type your name and a short description of the scenario. Click *Export* and select the file location to which the data will be saved. The file will be saved with an .ini extension. This file can be shared with others through standard file sharing protocols such as sending it as an email attachment. To import the .ini file, click the *Import Scenario* button. You will be prompted to enter a desired scenario name. Click *Import* and the new scenario file name should appear in the scenario list box.

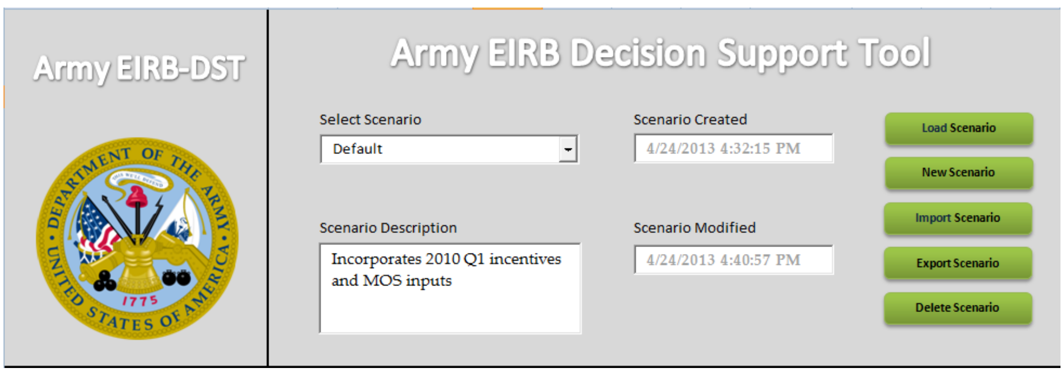
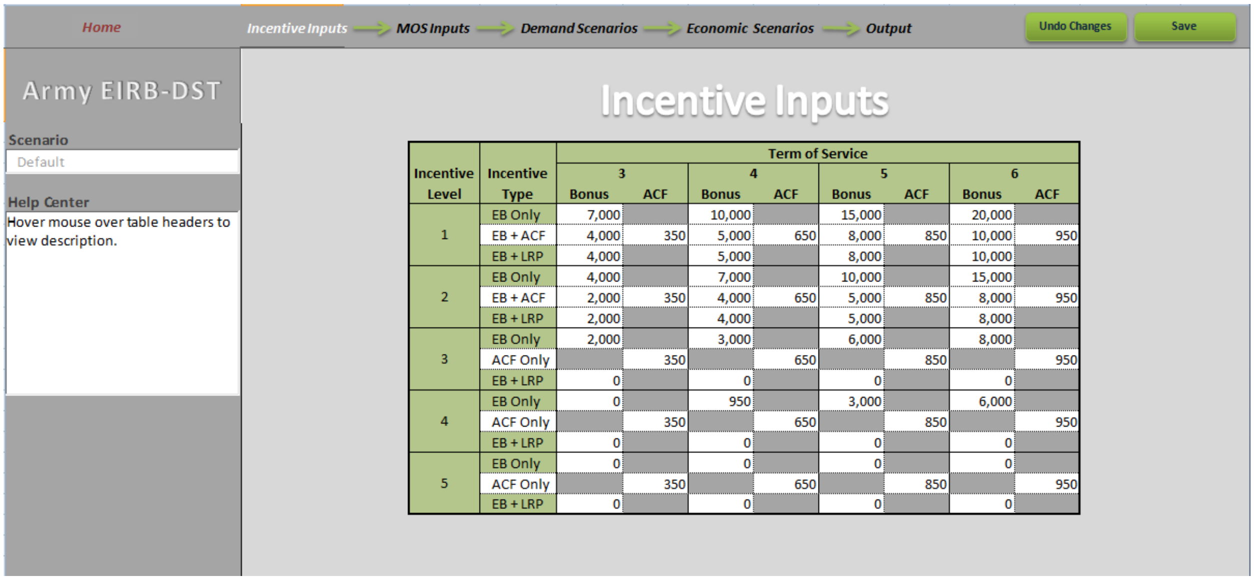


Figure 6: Home Screen

The **Incentive Inputs** page (see **Figure 7**) allows you to change the incentive amounts for the different incentive levels. The cells that have a background color of white are the cells that can be edited. Please note that the ACF options are currently disabled in the model. You may set Enlistment Bonus levels for both the Enlistment Bonus only and Enlistment Bonus plus Loan Repayment Program options for each incentive level. There are five incentive levels in the model, although individual jobs (MOS) may also be assigned a sixth level (no incentives).



Incentive Level	Incentive Type	Term of Service 3 Bonus	3 ACF	4 Bonus	4 ACF	5 Bonus	5 ACF	6 Bonus	6 ACF
1	EB Only	7,000		10,000		15,000		20,000	
	EB + ACF	4,000	350	5,000	650	8,000	850	10,000	950
	EB + LRP	4,000		5,000		8,000		10,000	
2	EB Only	4,000		7,000		10,000		15,000	
	EB + ACF	2,000	350	4,000	650	5,000	850	8,000	950
	EB + LRP	2,000		4,000		5,000		8,000	
3	EB Only	2,000		3,000		6,000		8,000	
	ACF Only		350		650		850		950
	EB + LRP	0		0		0		0	
4	EB Only	0		950		3,000		6,000	
	ACF Only		350		650		850		950
	EB + LRP	0		0		0		0	
5	EB Only	0		0		0		0	
	ACF Only		350		650		850		950
	EB + LRP	0		0		0		0	

Figure 7: Incentive Inputs Screen

> *From this page forward, navigation links can be found on the top portion of the screen. The active page name is displayed in a white font to demonstrate progress through the model. In addition, the scenario name is displayed in the upper left hand corner of each page. Directly underneath the scenario name is a help center box where relevant instructions will appear when a user places his or her mouse over an applicable area of the screen. To change the scenario, click the Home link located in the upper left hand corner of the page.*

Each page has a *Save* button that provides you with the ability to save changes to your scenarios. Clicking the button will open a form that provides two save options: *Save Scenario* and *Save As New Scenario. Save Scenario* saves the scenario inputs for all sheets (see Figure 8). *Save As New Scenario* creates a replica of the current scenario inputs. Both the *Save Scenario* and *Save As New Scenario* buttons only save the model inputs. The output is saved in MS Access after the output procedure is completed.

In addition to the *Save Values* feature, each page allows you to undo changes made to a page by clicking the *Undo Changes* button. Please note that clicking the *Save Values* button will establish a new save point to which clicking the *Undo Changes* button will revert; i.e. clicking the *Undo Changes* button will set all values back to this point.

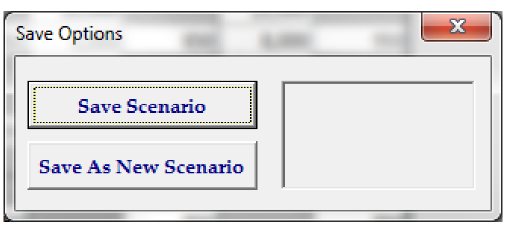
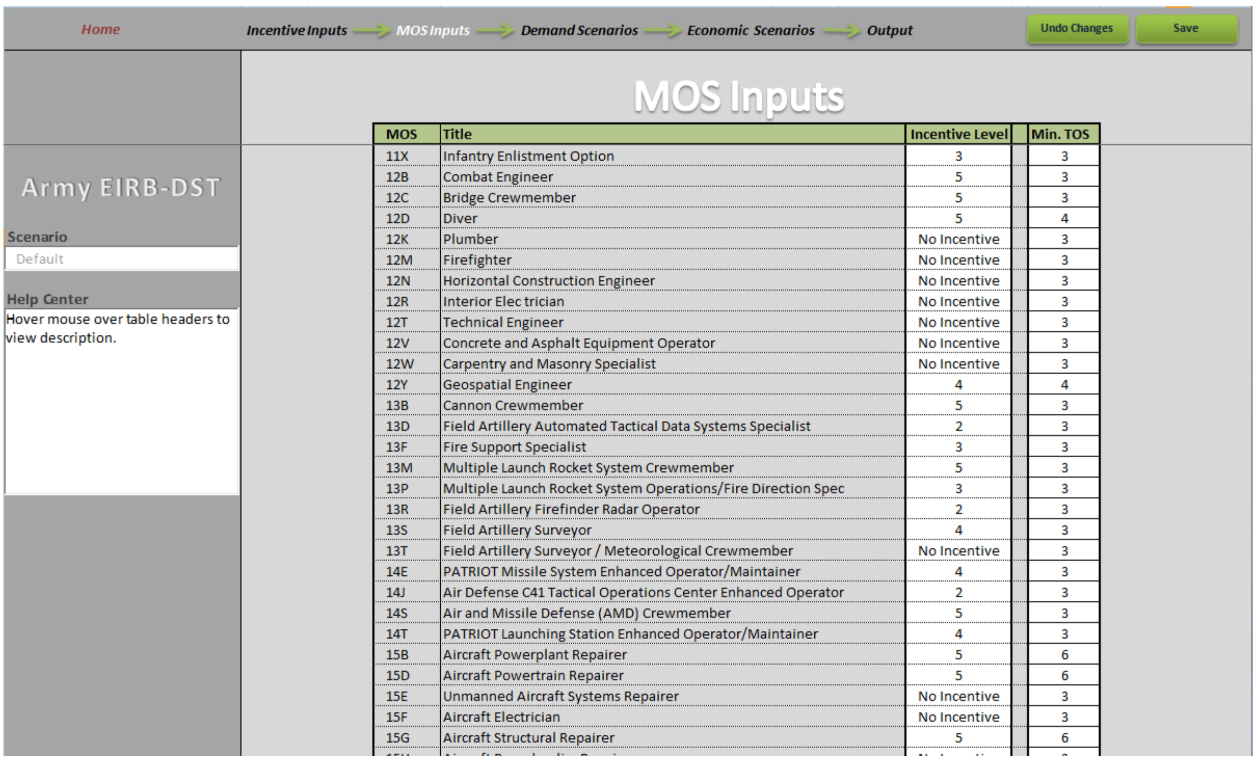


Figure 8. Save Options Form

The **MOS Inputs** page (see Figure 9) allows you to select an incentive level and minimum term of service for each MOS job category. For the incentive levels, you may set the value to any value between one and five or choose “No Incentive”. In addition, you may set the value of minimum term of service to any value between three and six. The values for each incentive level and minimum term of service were constructed on the **Incentive Inputs** page.

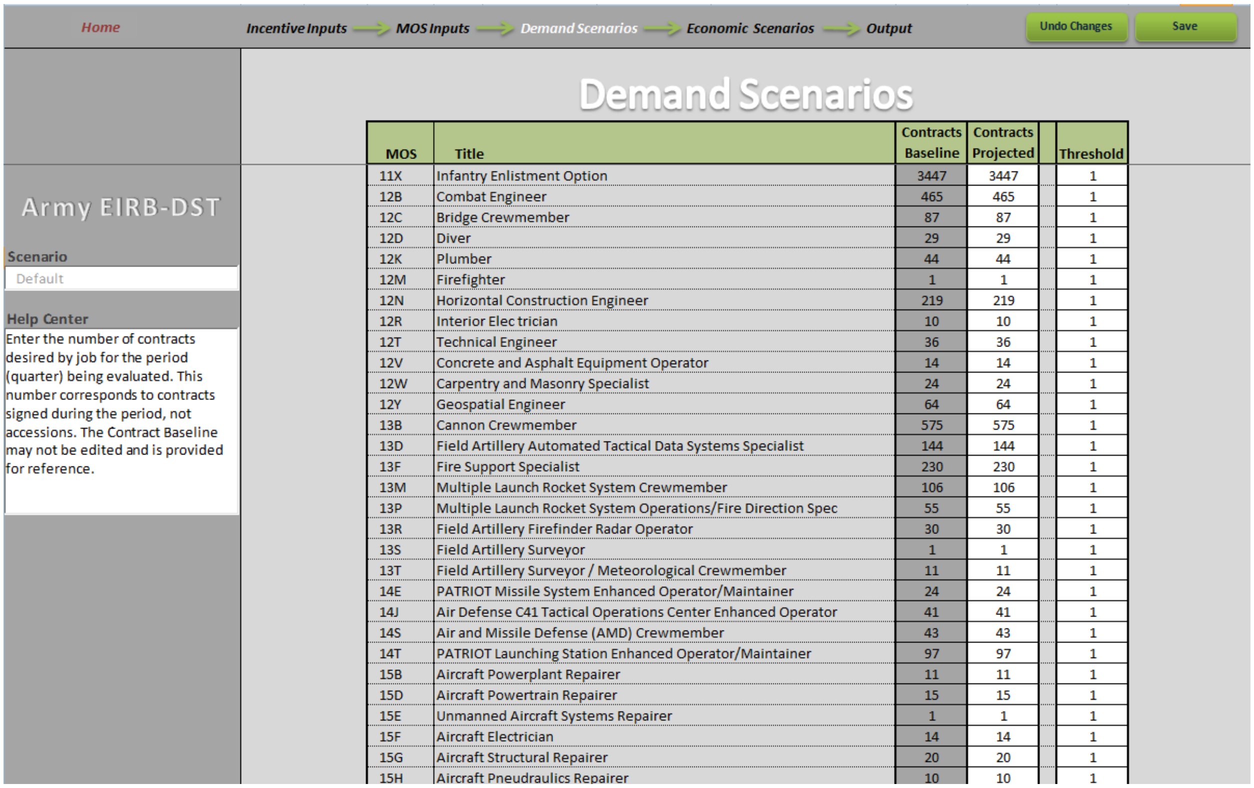
Because there are more MOS codes than can fit on a screen, you must scroll down in order to select an incentive level and minimum term of service for each job category. If you would like to see the scenario name and help center boxes while scrolled down on the screen, click on an empty cell and the boxes will appear on the left hand side of the screen.



MOS	Title	Incentive Level	Min. TOS
11X	Infantry Enlistment Option	3	3
12B	Combat Engineer	5	3
12C	Bridge Crewmember	5	3
12D	Diver	5	4
12K	Plumber	No Incentive	3
12M	Firefighter	No Incentive	3
12N	Horizontal Construction Engineer	No Incentive	3
12R	Interior Elec trician	No Incentive	3
12T	Technical Engineer	No Incentive	3
12V	Concrete and Asphalt Equipment Operator	No Incentive	3
12W	Carpentry and Masonry Specialist	No Incentive	3
12Y	Geospatial Engineer	4	4
13B	Cannon Crewmember	5	3
13D	Field Artillery Automated Tactical Data Systems Specialist	2	3
13F	Fire Support Specialist	3	3
13M	Multiple Launch Rocket System Crewmember	5	3
13P	Multiple Launch Rocket System Operations/Fire Direction Spec	3	3
13R	Field Artillery Firefinder Radar Operator	2	3
13S	Field Artillery Surveyor	4	3
13T	Field Artillery Surveyor / Meteorological Crewmember	No Incentive	3
14E	PATRIOT Missile System Enhanced Operator/Maintainer	4	3
14J	Air Defense C41 Tactical Operations Center Enhanced Operator	2	3
14S	Air and Missile Defense (AMD) Crewmember	5	3
14T	PATRIOT Launching Station Enhanced Operator/Maintainer	4	3
15B	Aircraft Powerplant Repairer	5	6
15D	Aircraft Powertrain Repairer	5	6
15E	Unmanned Aircraft Systems Repairer	No Incentive	3
15F	Aircraft Electrician	No Incentive	3
15G	Aircraft Structural Repairer	5	6

Figure 9: MOS Inputs Screen

After selecting incentive levels and minimum terms of service for each MOS code, you are guided to the **Demand Scenarios** page (see Figure 10), where you enter the contract requirement and threshold for each MOS job specialty. On the **Demand Scenarios** page, there are baseline contracts, derived from Target Reports to represent Q4 of a fiscal year, as well as an adjacent column used to input the contract requirements for the model. The threshold value is in terms of a percentage–e.g., a value of 1 means the job will be filled when it has 100% of its contract requirement, and a value of .95 means the job will be filled when it has 95% of its contract requirement.



MOS	Title	Contracts Baseline	Contracts Projected		Threshold
11X	Infantry Enlistment Option	3447	3447		1
12B	Combat Engineer	465	465		1
12C	Bridge Crewmember	87	87		1
12D	Diver	29	29		1
12K	Plumber	44	44		1
12M	Firefighter	1	1		1
12N	Horizontal Construction Engineer	219	219		1
12R	Interior Elec trician	10	10		1
12T	Technical Engineer	36	36		1
12V	Concrete and Asphalt Equipment Operator	14	14		1
12W	Carpentry and Masonry Specialist	24	24		1
12Y	Geospatial Engineer	64	64		1
13B	Cannon Crewmember	575	575		1
13D	Field Artillery Automated Tactical Data Systems Specialist	144	144		1
13F	Fire Support Specialist	230	230		1
13M	Multiple Launch Rocket System Crewmember	106	106		1
13P	Multiple Launch Rocket System Operations/Fire Direction Spec	55	55		1
13R	Field Artillery Firefinder Radar Operator	30	30		1
13S	Field Artillery Surveyor	1	1		1
13T	Field Artillery Surveyor / Meteorological Crewmember	11	11		1
14E	PATRIOT Missile System Enhanced Operator/Maintainer	24	24		1
14J	Air Defense C41 Tactical Operations Center Enhanced Operator	41	41		1
14S	Air and Missile Defense (AMD) Crewmember	43	43		1
14T	PATRIOT Launching Station Enhanced Operator/Maintainer	97	97		1
15B	Aircraft Powerplant Repairer	11	11		1
15D	Aircraft Powertrain Repairer	15	15		1
15E	Unmanned Aircraft Systems Repairer	1	1		1
15F	Aircraft Electrician	14	14		1
15G	Aircraft Structural Repairer	20	20		1
15H	Aircraft Pneudraulics Repairer	10	10		1

Figure 10: Demand Scenarios Screen

The **Economic Scenarios** page (see Figure 11) includes input factors for the projected year relating to:

- ***Unemployment Rate:*** *the national unemployment rate;*
- ***Relative Military Pay:*** *the ratio of annual military compensation to the annual compensation for an equivalent civilian occupation. See page 18 for more details;*
- ***Production Recruiters:*** *number of active component enlisted recruiters; and*
- ***Advertising:*** *total annual advertising obligations attributed to enlisted programs.*

The page has baseline values associated with these parameters located adjacent to the input boxes. The **Economic Scenarios** page also includes the supply parameters that are used when calculating the adjustment to the applicant weights.

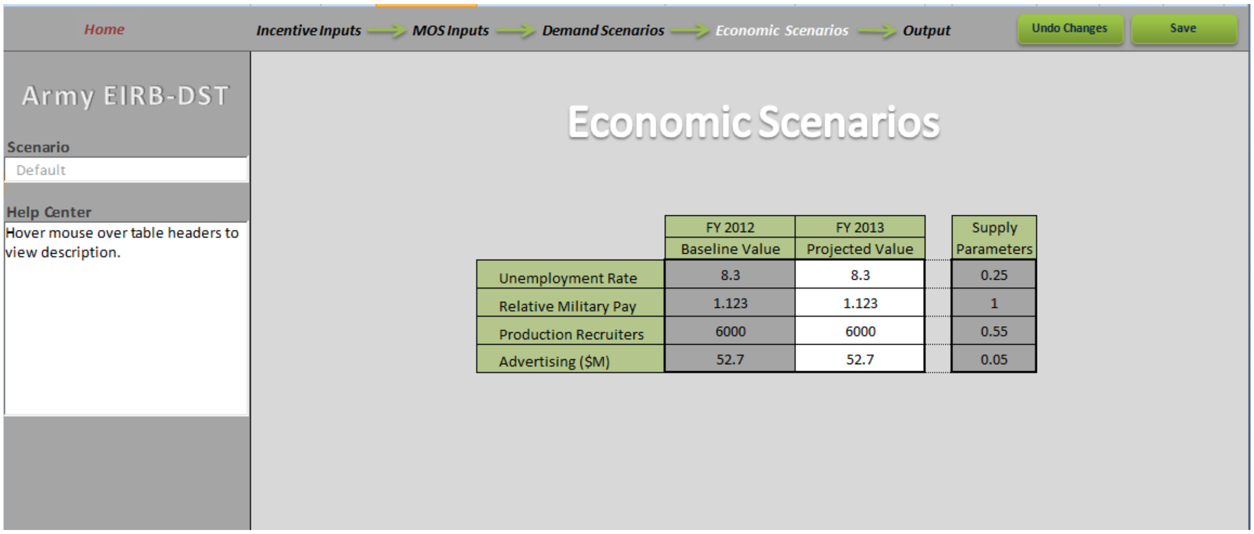


Figure 11: Economic Scenarios Screen

Output Reporting

By clicking on the *Output* text on the model flow at the top of the screen, the simulation will run and it will take you to the **Summary** page (see Figure 12). The EIRB-DST output is divided up into four different reports.

1. The **Summary** Report,
2. The **Summary by TOS** Report,
3. The **Scenario Comparison** Report and,
4. The **Met Contract Req.** Report

The **Summary** screen acts as the output main screen. Through that worksheet, you can access the other three output pages by pressing the respective buttons in the summary reports box in the upper-right hand corner. The **Summary** page displays the Total Contracts, Total Incentive Takers, Total EB Cost, Total ACF Cost, and Total LRP Cost for the chosen scenario by MOS.

MOS	No Contract	Total Incentive Takers	Total EB Cost ($K)	Total ACF Cost ($K)	Total LRP Cost ($K)
	Total	7,393	$20,325.84	$0.00	$7,278.52
		-----	-----	-----	-----
11X		1,851	$6,863.36	$0.00	$1,579.88
12B		224	$937.19	$0.00	$188.09
12C		22	$66.64	$0.00	$13.52
12D		29	$0.00	$0.00	$90.27
12K		11	$28.77	$0.00	$5.88
12M		0	$0.00	$0.00	$0.00
12N		108	$446.33	$0.00	$89.85
12R		7	$15.54	$0.00	$3.64
12T		34	$0.00	$0.00	$100.99
12V		6	$27.96	$0.00	$6.09
12W		0	$0.00	$0.00	$0.00
12Y		34	$0.00	$0.00	$105.67
13B		170	$357.18	$0.00	$86.13
13D		89	$292.05	$0.00	$68.38
13F		0	$0.00	$0.00	$0.00
13M		13	$0.00	$0.00	$41.70
13P		26	$51.14	$0.00	$13.48
13R		23	$63.03	$0.00	$16.49
13S		0	$0.00	$0.00	$0.00
13T		9	$0.00	$0.00	$27.89
14E		21	$36.68	$0.00	$9.72
14J		34	$86.85	$0.00	$23.92
14S		0	$0.00	$0.00	$0.00
14T		11	$0.00	$0.00	$35.49
15B		9	$17.90	$0.00	$4.52
15D		11	$32.20	$0.00	$8.75
15E		0	$0.00	$0.00	$0.00
15F		12	$0.00	$0.00	$36.03
15G		17	$31.67	$0.00	$9.01
15H		8	$22.73	$0.00	$5.27
15J		0	$0.00	$0.00	$0.00
15N		10	$0.00	$0.00	$36.32
15P		17	$41.80	$0.00	$9.58
15Q		31	$80.20	$0.00	$22.94

Figure 12: Summary Page

The **Summary by TOS** page (see Figure 13) displays the same information but includes further distinction by showing each category by term of service (TOS). You can return to the **Summary** page by pressing the *Summary Home* button at the top of the page.

Scenario

Default

Summary Home

	All Contracts					Incentive-Eligible Only					Enlistment Bonus Cost ($K)			
	Total Contracts	Term of Service				Total Incentive Takers	Term of Service				Total EB Cost	Term of Service		
MOS Group		3	4	5	6		3	4	5	6		3	4	5
Total Contracts	12,443	5,020	3,968	1,342	2,113	7,393	2,209	2,985	1,049	1,150	$20,325.84	$7,198.50	$5,278.99	$2,787.97
No Contract	5,293	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
11X	3,453	2,334	751	173	195	1,851	1,029	530	130	162	$6,863.36	$3,358.52	$1,635.77	$727.70
12B	466	313	99	23	30	224	119	64	16	25	$937.19	$450.14	$215.66	$96.58
12C	46	0	32	7	7	22	0	14	4	4	$66.64	$0.00	$22.38	$15.03
12D	29	0	0	15	14	29	0	0	15	14	$0.00	$0.00	$0.00	$0.00
12K	19	0	13	3	3	11	0	7	2	2	$28.77	$0.00	$9.21	$6.23
12M	1	0	0	0	1	0	0	0	0	0	$0.00	$0.00	$0.00	$0.00
12N	220	144	50	12	14	108	56	33	8	12	$446.33	$206.85	$108.64	$49.54
12R	10	0	7	2	2	7	0	5	1	1	$15.54	$0.00	$4.65	$3.25
12T	36	0	0	19	17	34	0	0	18	16	$0.00	$0.00	$0.00	$0.00
12V	14	9	3	1	1	6	3	2	0	1	$27.96	$13.59	$6.63	$3.00
12W	13	0	0	0	13	0	0	0	0	0	$0.00	$0.00	$0.00	$0.00
12Y	45	0	0	24	21	34	0	0	18	16	$0.00	$0.00	$0.00	$0.00
13B	237	0	162	36	38	170	0	113	27	31	$357.18	$0.00	$111.98	$76.79
13D	144	95	33	8	9	89	50	25	6	8	$292.05	$135.90	$71.78	$32.38
13F	22	0	0	0	22	0	0	0	0	0	$0.00	$0.00	$0.00	$0.00
13M	17	0	0	9	8	13	0	0	7	7	$0.00	$0.00	$0.00	$0.00
13P	34	0	23	5	5	26	0	18	4	5	$51.14	$0.00	$15.93	$11.12
13R	30	18	8	2	2	23	13	7	2	2	$63.03	$26.22	$16.74	$7.76
13S	1	0	0	0	1	0	0	0	0	0	$0.00	$0.00	$0.00	$0.00
13T	11	0	0	6	5	9	0	0	5	4	$0.00	$0.00	$0.00	$0.00
14E	24	0	16	4	4	21	0	14	3	4	$36.68	$0.00	$11.29	$7.93
14J	41	25	11	3	3	34	19	10	2	3	$86.85	$35.31	$23.39	$10.82
14S	9	0	0	0	9	0	0	0	0	0	$0.00	$0.00	$0.00	$0.00
14T	14	0	0	8	7	11	0	0	6	6	$0.00	$0.00	$0.00	$0.00
15B	11	0	7	2	2	9	0	6	1	2	$17.90	$0.00	$4.99	$3.53
15D	15	9	4	1	1	11	6	3	1	1	$32.20	$13.03	$8.14	$3.87
15E	1	0	0	0	1	0	0	0	0	0	$0.00	$0.00	$0.00	$0.00
15F	14	0	0	7	7	12	0	0	6	6	$0.00	$0.00	$0.00	$0.00
15G	20	0	13	3	4	17	0	11	3	3	$31.67	$0.00	$9.03	$6.39
15H	11	6	3	1	1	8	4	2	1	1	$22.73	$9.23	$5.68	$2.72
15J	43	0	0	0	43	0	0	0	0	0	$0.00	$0.00	$0.00	$0.00
15N	13	0	0	7	6	10	0	0	5	5	$0.00	$0.00	$0.00	$0.00

Figure 13: Summary by TOS Page

Pressing the *Compare Scenarios* button will take you to the **Summary Comparison** page (see Figure 14). This page allows you to compare the summary reports of two different scenarios. This page also includes a *Difference* column that reports the difference between "Scenario B" and "Scenario A." You can return to the **Summary** page by pressing the *Summary Home* button at the top of the page.

Figure 14: Summary Comparison

The third report is the **Met Contract Req.** page (see **Figure 15**). This report allows you to see the point at which an MOS was filled. The numbers represent the time in the simulation when the job was filled. The values are normalized so that a value of 95 means that the simulation was 95% complete when the job was filled. A value of 100 means that the job was not filled. You can return to the **Summary** page by pressing the *Summary Home* button at the top of the page.

Figure 15: Met Contract Req. Page

The **Summary** page also includes four other buttons. Pressing the *Return Home* button will take you back to the **Home** screen. The *Save* button will allow you to save the inputs that created the output you

are looking at. The *Return to Model* button takes you back to the last input page you had accessed prior to accessing the **Summary** page. The *Redo Simulation* button will create new output for the scenario that is displayed in the top-left hand corner of the **Summary** page.

Annual Maintenance

The intention of this section is to describe all input data and (where applicable) sources for updates.

Updating Economic Baseline Information

This documentation is intended to familiarize you with the updates to the data. At the beginning of each fiscal year, baseline information should be updated to refer to the previous fiscal year. The unemployment rate is directly available through online resources while other parameter estimates must be supplied through contributing departments in the Army. Baseline data sources and brief descriptions are displayed in **Table 1**.

Table 1: Baseline Data Updates

Unemployment Rate	This is the average unemployment rate that prevailed during the months in the base fiscal year.	bls.gov
Relative Military Pay	This is a measure of the ratio of current military pay to civilian pay.	Civilian pay: http://www.bls.gov/oes/oes_dl.htm Military pay: http://www.dfas.mil/militarymembers/payentitlements/militarypaytables.html
Production Recruiters	This is the total number of Army active component enlisted recruiters.	Army MPA Budget Justification Book
Advertising	This record represents the total general enlisted advertising obligations. It was assumed that 9% of the total advertising obligations in each fiscal year were attributed to this category of advertising spending.	Army O&M Budget Justification Book
Goals	This is the quota for the number of enlisted personnel in each MOS job code. The estimated contract goals should be calculated based on the same period in the previous year. For example, to estimate goals for FY 2013, Q3, compare Target reports for 31 March 2012 and 30 June 2012.	Goals can be estimated from the Target report produced by HRC. Since the Target report comes from a live database, it will be necessary to get quarterly copies of the report.

Baseline data updates should be performed centrally and be distributed to users so that they are consistent.

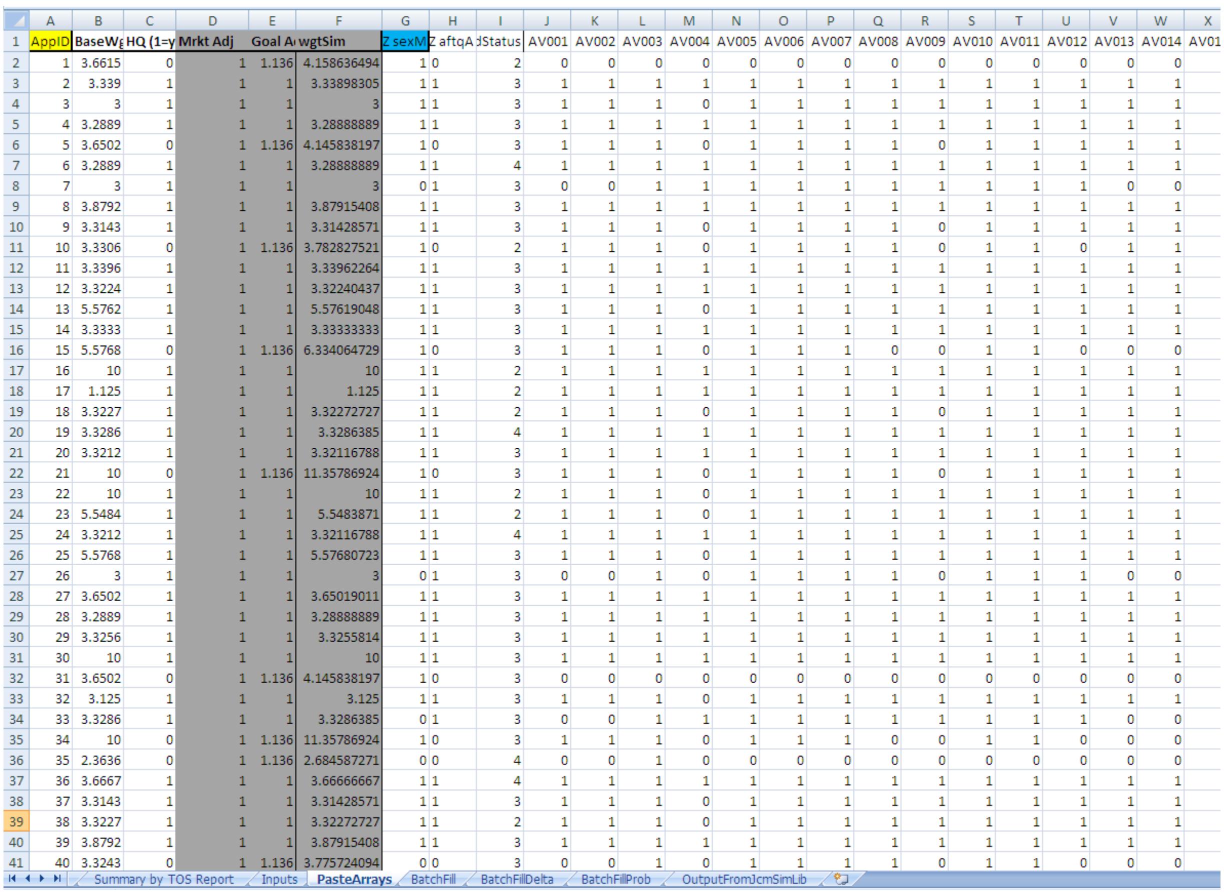
Updating Variables for Probability Module

The probability module reads values from the models **Input** and **PasteArrays** worksheets and creates arrays with those values. The values from the **PasteArrays** worksheet are copied from another workbook, *EIRBII_Calculations.xlsx*, where the applicant data is stored and the different variables used in creating the arrays are calculated.

If you need to use another set of applicant data, follow the following steps:

1. Open up EIRBII_Calculations.xlsx and go to the sheet named **ApplicantData**
2. Copy the new applicant data from the text file (press Ctrl + A) and paste the values in cell A1

Once the raw applicant data is copied into the *EIRBII_Calculations.xlsx* worksheet, all you need to do is run the *ImpAppData* module in the model workbook. This module will read the applicant data in the *EIRBII_Calculations.xlsx* worksheet and copy those values into the model so they can be read into the model routine.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1	AppID	BaseW€	HQ (1=y	Mrkt Adj	Goal A	wgtSim	Z sexM	Z aftqA	dStatus	AV001	AV002	AV003	AV004	AV005	AV006	AV007	AV008	AV009	AV010	AV011	AV012	AV013	AV014	AV01
2	1	3.6615	0	1	1.136	4.158636494	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
3	2	3.339	1	1	1	3.33898305	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
4	3	3	1	1	1	3	1	1	3	1	1	1	0	1	1	1	1	1	1	1	1	1	1	
5	4	3.2889	1	1	1	3.28888889	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
6	5	3.6502	0	1	1.136	4.145838197	1	0	3	1	1	1	0	1	1	1	1	0	1	1	1	1	1	
7	6	3.2889	1	1	1	3.28888889	1	1	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
8	7	3	1	1	1	3	0	1	3	0	0	1	1	1	1	1	1	1	1	1	1	0	0	
9	8	3.8792	1	1	1	3.87915408	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
10	9	3.3143	1	1	1	3.31428571	1	1	3	1	1	1	0	1	1	1	1	0	1	1	1	1	1	
11	10	3.3306	0	1	1.136	3.782827521	1	0	2	1	1	1	0	1	1	1	1	0	1	1	0	1	1	
12	11	3.3396	1	1	1	3.33962264	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
13	12	3.3224	1	1	1	3.32240437	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
14	13	5.5762	1	1	1	5.57619048	1	1	3	1	1	1	0	1	1	1	1	1	1	1	1	1	1	
15	14	3.3333	1	1	1	3.33333333	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
16	15	5.5768	0	1	1.136	6.334064729	1	0	3	1	1	1	0	1	1	1	0	0	1	1	0	0	0	
17	16	10	1	1	1	10	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
18	17	1.125	1	1	1	1.125	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
19	18	3.3227	1	1	1	3.32272727	1	1	2	1	1	1	0	1	1	1	1	0	1	1	1	1	1	
20	19	3.3286	1	1	1	3.3286385	1	1	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
21	20	3.3212	1	1	1	3.32116788	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
22	21	10	0	1	1.136	11.35786924	1	0	3	1	1	1	0	1	1	1	1	0	1	1	1	1	1	
23	22	10	1	1	1	10	1	1	2	1	1	1	0	1	1	1	1	1	1	1	1	1	1	
24	23	5.5484	1	1	1	5.5483871	1	1	2	1	1	1	0	1	1	1	1	1	1	1	1	1	1	
25	24	3.3212	1	1	1	3.32116788	1	1	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
26	25	5.5768	1	1	1	5.57680723	1	1	3	1	1	1	0	1	1	1	1	1	1	1	1	1	1	
27	26	3	1	1	1	3	0	1	3	0	0	1	0	1	1	1	1	0	1	1	1	0	0	
28	27	3.6502	1	1	1	3.65019011	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
29	28	3.2889	1	1	1	3.28888889	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
30	29	3.3256	1	1	1	3.3255814	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
31	30	10	1	1	1	10	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
32	31	3.6502	0	1	1.136	4.145838197	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
33	32	3.125	1	1	1	3.125	1	1	3	1	1	1	0	1	1	1	1	1	1	1	1	1	1	
34	33	3.3286	1	1	1	3.3286385	0	1	3	0	0	1	1	1	1	1	1	1	1	1	1	0	0	
35	34	10	0	1	1.136	11.35786924	1	0	3	1	1	1	0	1	1	1	0	0	1	1	0	0	0	
36	35	2.3636	0	1	1.136	2.684587271	0	0	4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	
37	36	3.6667	1	1	1	3.66666667	1	1	4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
38	37	3.3143	1	1	1	3.31428571	1	1	3	1	1	1	0	1	1	1	1	1	1	1	1	1	1	
39	38	3.3227	1	1	1	3.32272727	1	1	2	1	1	1	0	1	1	1	1	1	1	1	1	1	1	
40	39	3.8792	1	1	1	3.87915408	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
41	40	3.3243	0	1	1.136	3.775724094	0	0	3	0	0	1	0	1	1	1	1	0	1	1	0	0	0	

Figure 16: PasteArrays Screen

Technical Appendix

This section will contain further descriptions of the technical aspects of the model.

Baseline Data and Definitions

1. Unemployment Rate

Data Source: Current Population Survey (CPS) from the Bureau of Labor Statistics (BLS).

Definition: Seasonally adjusted monthly unemployment rate (unemployed/labor force) for men and women 16 years and over averaged over the entire fiscal year.

2. Relative Military Pay

Data Source:

Civilian Pay: Data came from Occupational Employment Statistics (OES) data for civilian pay. When civilian pay is used, it is taken from category "17" in the OES data, which represents the general "Architect and Engineer" occupation. Here is the ink to the state-level OES data: http://www.bls.gov/oes/oes_dl.htm.

Military Pay: Data came from OSD (Compensation) spreadsheets containing annual regular military compensation (RMC) and monthly basic pay by rank and YOS. For the baseline, military pay (RMC) was assumed to be that of a junior officer (O-3 at YOS 4) from tables containing RMC by rank and years of service. Source of tables of monthly military basic pay (which comprises about 2/3 of RMC): http://www.dfas.mil/militarymembers/payentitlements/militarypaytables.html

Definition: The year relative pay index was constructed using the average annual wage in the "Architect and Engineer" occupation in conjunction with military pay (RMC) of a junior officer (O-3 at YOS 4). The formula for the pay index is:

$$\frac{\left(\frac{Current\ Military\ Pay}{Military\ pay\ from\ 2000}\right)}{\left(\frac{Current\ Civilian\ Pay}{Civilian\ pay\ from\ 2000}\right)}$$

3. Production Recruiters

Data Source: Army MPA Budget Justification Book

Definition: Total number of Army active component enlisted recruiters

4. Advertising

Data Source: Army O&M Budget Justification Book

Definition: Total general enlisted advertising obligations. It was assumed that 9% of the total advertising obligations in each fiscal year were attributed to this category of advertising spending.